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INVESTIGATION OF MERCURY IN THE ST. CLAIR RIVER - LAKE ERIE SYSTEMS

National Field Investigations Center
Cincinnati, Ohio

May 1970

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INVESTIGATION OF MERCURY IN THE ST. CLAIR RIVER - LAKE ERIE SYSTEMS

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May 1970

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IN THE
ST. CLAIR RIVER - LAKE ERIE SYSTEMS

Federal Water Quality Administration
Great Lakes Regional Office
Lake Huron Basin Office
Lake Erie Basin Office
National Field Investigations Center

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This report was developed by personnel of the Great Lakes Regional Office, Lake Huron Basin Office, and Lake Erie Basin Office in cooperation with personnel of the National Field Investigations Center.

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INVESTIGATION OF MERCURY IN THE ST. CLAIR RIVER - LAKE ERIE SYSTEMS

SUMMARY AND CONCLUSIONS

1. Data provided by the Bureau of Commercial Fisheries, Technological Laboratory, Ann Arbor, Michigan, show that mercury was present in fish throughout the St. Clair River - Lake Erie System. Concentrations (parts per million, wet weight) in the edible portions of various fish were:

Yellow Perch	0.32 to 1.70
Northern Pike	0.64
Coho Salmon	0.24 to 0.96
Carp	0.08 to 0.28
White Bass	0.53 to 0.80
Steelhead	<0.15
Walleye Pike	1.4 to 3.57
Channel Catfish	0.32 to 1.8
Gizzard Shad	0.24
Sucker	0.88
Sheepshead	0.24

2. Available information indicates that no measurable concentration of mercury was present in water supply intakes in the St. Clair - Lake Erie System.

3. Mercury in excess of 1 mg/kg dry weight was present in sediments in the Erie, Pennsylvania, and Euclid and Cleveland, Ohio, areas and the Buffalo, Black, and Ashtabula rivers. Results of analyses indicate the following levels of mercury in the areas specified:

AREA	MERCURY LEVELS IN SEDIMENT (mg/kg dry weight)
St. Clair River	Mercury was present at mile points 37.0, 33.0, and 25.5 in concentrations of 1.0, 0.2, and 0.3 mg/kg, respectively. All other samples indicated the presence of mercury.
Lake St. Clair	Six sediment samples in the navigation channel, off-shore from the mouth of the St. Clair River, contained mercury at concentrations ranging from 0.3 to 9.2 mg/l. Samples from a dredging disposal area had concentrations of 1.7 and 2.1 mg/kg. All other samples indicated the presence of mercury.
Upper Detroit River (Headwaters to Grassy Island)	Mercury was not measurable at the head of the Detroit River, but ranged from 1.4 mg/kg in backwater areas along the U. S. shore upstream from the Rouge River and as high as 2.0 mg/kg in backwater areas downstream from the Rouge.
Lower Detroit River Trenton Channel	In a narrow strip of about 20 to 100 feet along the U. S. shoreline concentrations ranged from 86.0 to 5.4 mg/kg within a mile downstream from the Wyandotte Chemicals' outfall and then vary from 26.0 mg/kg to trace amounts downstream to Lake Erie, depending on the settling characteristics at the specific point.

Main Channel of Detroit River	One sample collected between Grassy Island and Grosse Ile contained 4.4 mg/kg of mercury; one on the east side of Fighting Island contained 1.2 mg/kg; and one near the Canadian shore near the mouth contained 0.6 mg/kg.
Northern Grosse Ile	Mercury was not present in measurable amounts in samples along the northern part of Grosse Ile, the area of Wyandotte Chemicals' waste beds, but trace amounts were indicated.
Western Lake Erie Michigan Waters	Concentrations near the Detroit Light varied from 1.0 to 2.1 mg/kg. Along the Michigan shore, mercury was not measurable. Near LaPlaisance Bay one sample contained 0.8 mg/kg.
Ohio Waters	Four points near West Sister Island had concentrations ranging from 1.6 to 2.1 mg/kg. In other areas nearer the shore, mercury was not measurable.
Canadian Waters	Concentrations of 1.3 to 2.7 mg/kg were present at three points extending eastward about 15 miles from the Detroit Light and about 5 miles from the Ontario shore. Points extending to Pelee Island had no measurable mercury.
Eastern Lake Erie Ohio Waters	Concentrations of 2.0 and 2.4 mg/kg were present off shore from mouth of the Grand River and Cleveland Harbor, respectively. Off shore from the Cleveland Easterly Sewage Treatment Plant, a concentration of 4.0 mg/kg occurred.

Pennsylvania Waters	A concentration of 1.1 mg/kg was present in a sample from Presque Isle Bay.
Tributaries	Concentrations in excess of 1.0 mg/kg were present in the Black, Ashtabula, and Buffalo rivers. In the Rouge, Huron, Maumee, Sandusky, Portage, Rocky, Cuyahoga, Grand, and Raisin rivers, the concentrations were less than 1.0 mg/kg.

4. The waters of the study area revealed no mercury except for one sample collected at mile point 13.3 in the Trenton Channel downstream from the Wyandotte Chemical Company; this concentration was 0.03 mg/l.
5. The Detroit River area is the primary source of mercury in the western end of Lake Erie. This is revealed by the distribution pattern established through sediment samples.
6. Because of mercury discharges, the State of Michigan stopped the production of chlorine by Wyandotte Chemicals Corporation until a treatment system was developed and the mercury-bearing wastes were removed from the receiving waters.
7. The State of Ohio issued an order to the Detrex Chemical Industries, Inc., Ashtabula, Ohio, on April 13, 1970, to " . . . cease and desist the discharge of liquid industrial waste containing any mercurial compounds to waters of the state." Some operational changes were made but data collected on

May 11, 1970, indicate that Detrex still discharged 1.2 pounds of mercury per day.

8. Allied Chemical Co., Buffalo Dye Division, Buffalo, New York, is a source of mercury to the Buffalo River. On May 8, 1970, a sample of the plant effluent revealed 0.12 mg/l mercury. The company stated that the process utilizing mercury was not in use on that day. Based on this information, Allied Chemical Co. was discharging approximately 4 pounds of mercury per day from sources other than the reported production of disulfo intermediates.

9. The discharge from Diamond Shamrock, Painesville, Ohio, to the Grand River had a concentration of 0.010 mg/l mercury on April 4, 1970.

10. Concentrations of 0.002 mg/l were present in the effluents from the Ann Arbor and Wayne County-Wyandotte, Michigan, waste water treatment plants. No measurable concentration of mercury was present in six other waste water treatment plant effluents investigated in Michigan (State data). Concentrations of 0.004, 0.003, and 0.004 mg/l mercury were present in Euclid and Cleveland Westerly and Southerly sewage treatment plant effluents, respectively. Although no measurable concentration of mercury was present in the Cleveland Easterly sewage treatment plant effluent, which receives wastes from several users of mercury, 4 mg/kg were present in Lake Erie sediments 100 feet north of the discharge point.

11. On May 7, 1970 a concentration of 0.011 mg/l mercury was present in the outfall from the National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio. This occurred during a period when there was no discharge from lagoons that supposedly receive all mercury wastes from known sources.

12. Investigations of additional potential dischargers of mercury to Lake Erie are in progress by the states and the Federal Water Quality Administration.

RECOMMENDATIONS

1. Surveillance and sampling programs be initiated by industries, municipalities, States and the Federal Government to locate and identify all sources or potential sources of mercury and to determine mercury concentrations in surface waters, land run-off, waste streams, aquatic life, and sediments.
2. All dischargers of mercury to surface or ground waters or to municipal or regional waste treatment plants, including Federal installations, be ordered to cease and desist.
3. Precautionary measures be taken by all users and possessors of mercury or mercurial compounds for any purpose to prevent accidental spills or other losses to the water environment.

INTRODUCTION

The toxic effects of mercury and its compounds in the water environment are well known and are documented in the literature. However, much remains to be learned on toxicity limits of the various mercurial compounds in the water environment. The upper limit of mercury in food, used by the Food and Drug Administration, is 0.5 parts per million wet weight. Limits have also been set for atmospheric concentrations and numerous cases of poisoning have been reported.

Critical pollution from mercury became apparent on March 24, 1970, in the Great Lakes. Mercury concentrations as high as 5000 parts per billion (or 5 ppm) were reported in some of the pickerel shipments from Canada and commercial fishing involved was suspended by Canada, then Ohio, Michigan and New York. The presence of mercury in fish and bottom sediments in the St. Clair River-Lake Erie system has confirmed the existence of an environmental problem of major scope.

Mercury is discharged to the water environment from industrial processes and uses of mercurial products. In 1968, mercury produced from mining in the United States was 2,194,000 pounds. The total amount used in 1968 however, was 5,732,000 pounds. Over 163 million pounds of mercury have been consumed in the United States in the present century, but little information is available on the final disposition of it and amounts accumulated in the environment.

Metallic mercury and mercurial compounds in liquid wastes are characterized by their high densities. Free mercury and the mercurous compounds form sludges and settle to the bottom of receiving waters. The mercuric compounds form precipitates with oxides, phosphates, sulfides and carbonates. The high density is responsible for the rapid deposition in bottom sediments where they persist, become subject to sediment transport and are available to the aquatic life.

Metallic mercury can be oxidized readily to divalent mercury ions under the conditions present at the bottom of lakes and rivers. This has been shown to occur experimentally as well. The divalent inorganic mercury produced has an extremely strong affinity for organic muds and is biologically methylated in the bottom sediments. Divalent organic mercury, when methylated, is readily released from the sediments into the water.

Many fish are bottom feeders or feed upon organisms which are bottom dwellers and therefore the hazard of mercury ingestion becomes very great. Fish also absorb mercury from the water through the gills and possibly the scales.

Since biological concentration of mercury occurs, the accumulation of mercury in the food chain is a matter of grave concern. A recent report[5] indicates a magnification or concentration of mercury of over a million in the protoplasm of bacterial species. It has been demonstrated that the concentration from water to pike is in the order of 3,000 or more.[6]

Uses of Mercury

Sources of mercury in the environment principally come from industrial processes utilizing a form of mercury and the use of mercurial products by man.,

The industrial uses in 1968 are listed in the following table:[1/]

	Thousand of Pounds
1. Electrical apparatus	1,492
2. Electrolytic preparation of chlorine and caustic soda	1,326
3. Paints	803
4. Charging new installations of chlorine and caustic soda cells	630
5. Industrial and control instruments	581
6. Agricultural uses	260
7. Dental preparations	158
8. Catalyst preparations	145
9. Laboratory uses	151
10. Pharmaceuticals	32
11. Paper and pulp uses	31
12. Amalgamation (mercury alloys)	20

Mercury is used as the cathode in the electrolytic manufacture of chlorine with caustic soda and hydrogen as by-products. Cell recharging to make up the various losses from this process was 26 percent of the total mercury used in 1968 by all industries. To maintain the mercury inventory it required purchases of 1.3 million pounds of mercury in 1968. Weak spent brines, acids from the chlorine driers, brine sludges and cell cleanings are discharged

to the water environment from this process. The mercury may be metallic mercury emulsion, soluble and insoluble mercury salts.

In 1968, 630,000 pounds of mercury were used in the start-up of new electrolytic installations. This amount eventually contributes to the cell losses.

Information from manufacturers of mercurials used for herbicides, fungicides and bactericides is not readily available. These compounds usually are produced in batch processes and require considerable clean up with possible losses of mercury.

In the paper and pulp industry, phenyl mercury acetate is used for slime control and ground wood pulp may contain up to 20 ppm of the fungicide.[4/] This mercury is either lost to the product or to the waste load during processing. In either case it becomes a waste.

Large quantities of mercury are used in the manufacture of electrical apparatus and industrial and control instruments such as mercury cells, arc lights, pumps and switches. This poses a hazard of loss during the manufacturing process.

Catalysts, containing 10 percent mercuric chloride are manufactured for use by the petrochemical industry. This is made by passing a water solution of mercuric chloride over carbon and is used for making vinyl chloride from acetylene. Another catalyst containing mercuric sulfate is used in processing acetylene to

acetaldehyde. There are losses to the water environment from these processes.

Paints, those used for mildew control as well as those having anti-fouling characteristics, contain mercury, usually in the organic form. Erosion from paint films containing these compounds is another source of loss to the environment.

Mercury is used in dentistry for the preparation of amalgams. Minor losses may result from this use.

Laboratory use of mercury in manometers, thermometers, calomel cells, standard cells and as reagents results in an occasional discharge to sewers. In large research centers or universities, the quantities can become appreciable.

Minor users of mercury are the pharmaceutical manufacturers and in amalgamation. In the pharmaceutical manufacture, diuretics and antiseptics, i.e. calomel, phenyl mercury acetate and merthiolate are made. Accidental spills are the source of loss to the water environment.

The recovery of gold and silver by mercury amalgam is a wet process and may result in rather high losses of mercury in the plant effluent.

Additional mercury is introduced to the water environment through the use of products containing mercurial compounds. The most wide-spread example of this is in the agricultural application of fungicides and pesticides, which results in losses during periods of run-off from the area to which they are applied.

References

1. Minerals Yearbook, 1968, Vol. 1-11, Metals, Minerals and Fuels, Bureau of Mines, Chapter on "Mercury" by J. M. West.

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3. Jernelov, P. "Biological Methylation of Mercury in Aquatic Organism," Nature, Vol. 223, No. 5207, pp. 753-754, August 16, 1969.

4. Smart, N. A. "Use and Residues of Mercury Compounds in Agriculture," Residue Reviews, Vol. 23, pp. 1-36. 1968.

5. Battelle Memorial Institute, Design of an Overview-System for Evaluating the Public-Health Hazard of Chemicals in the Environment, Appendix A, 1967.

6. Johnels, A. G., et al. "Pike (Esox lucius L.) and Some Other Aquatic Organisms in Sweden as Indicators of Mercury Contamination in the Environment," Oikos, 18(2): 323-333, 1967.

MERCURY ANALYSES IN THE ST. CLAIR RIVER, LAKE ST. CLAIR, DETROIT RIVER AND WESTERN LAKE ERIE

The FWQA-Lake Huron Basin Office (LHBO) initiated a water and sediment sampling and analysis program for mercury in the St. Clair River -- Lake Erie system immediately after the Canadian government announced the fishing ban in Lake St. Clair on March 24, 1970.

Sample collections were made by personnel from the Lake Huron Basin Office with assistance from the Michigan Water Resources Commission.

Water samples were collected with a surface grab-sampler. Sediment samples were obtained by the use of either a Petersen dredge or a drag line sampler. These devices penetrate the bottom to a depth of about one-fourth foot. Physical properties such as odor, color, and general composition of the bottom materials were recorded.

The State of Michigan reports no measurable mercury in any water supply intakes within this area.

State data on analyses of 24-hour composite samples from nine municipal waste water treatment plants revealed concentrations of 0.002 mg/l at the Ann Arbor, Michigan, and Wayne County-Wyandotte, Michigan, plants on April 14, 1970.

ST. CLAIR RIVER AND LAKE ST. CLAIR

One water sample and 26 sediment samples were collected and analyzed from Lake St. Clair (Table 1 and Figure 1). Six sediment samples in the navigation channel contained mercury in concentrations from 0.3 to 9.2 mg/kg dry weight. Two samples from a dredging disposal area contained mercury at concentrations of 3.7 and 2.1 mg/kg dry weight. In the other 18 sediment samples the presence of mercury was indicated, but was less than the measurable limit. The water sample contained less than the measurable limit.

Sampling of the St. Clair River began on March 26, 1970. Fifteen samples of sediments and six water samples were collected between river mile (R.M.) 10.4 and 37.0. Sediment samples from R.M. 37.0, 33.0, and 25.5 contained concentrations of 1.0, 0.2, and 0.3 mg/kg, respectively (Table 1 and Figure 1). The other 12 sediment samples contained less than the measurable limit of 0.5 mg/kg wet weight, but indicated that traces of mercury were present. The six water samples contained no measurable concentrations of mercury.

Table 1

MERCURY SURVEY

Sample Analysis Results

St. Clair River

Sample Collection Date	Location		Mercury Content		
			Sediment (mg/kg)		Water
	River Mile	Ft. from U.S. Shore	Wet Basis	Dry Basis	(mg/l)
1970					
3/26	10.4	20	< 0.5		< 0.01
"	10.6	1850			< 0.01
"	10.6	4120	< 0.5		< 0.01
"	17.5	20	< 0.5		< 0.01
"	17.5	1500			< 0.01
"	17.5	2700	< 0.5		< 0.01
4/30	35.4	100	< 0.5		
"	33.5	100	< 0.5		
"	31.5	100	< 0.5		
"	29.5	100	< 0.5		
"	27.5	100	< 0.5		
"	23.5	100	< 0.5		
"	21.5	100	< 0.5		
"	19.5	100	< 0.5		

FIGURE 1

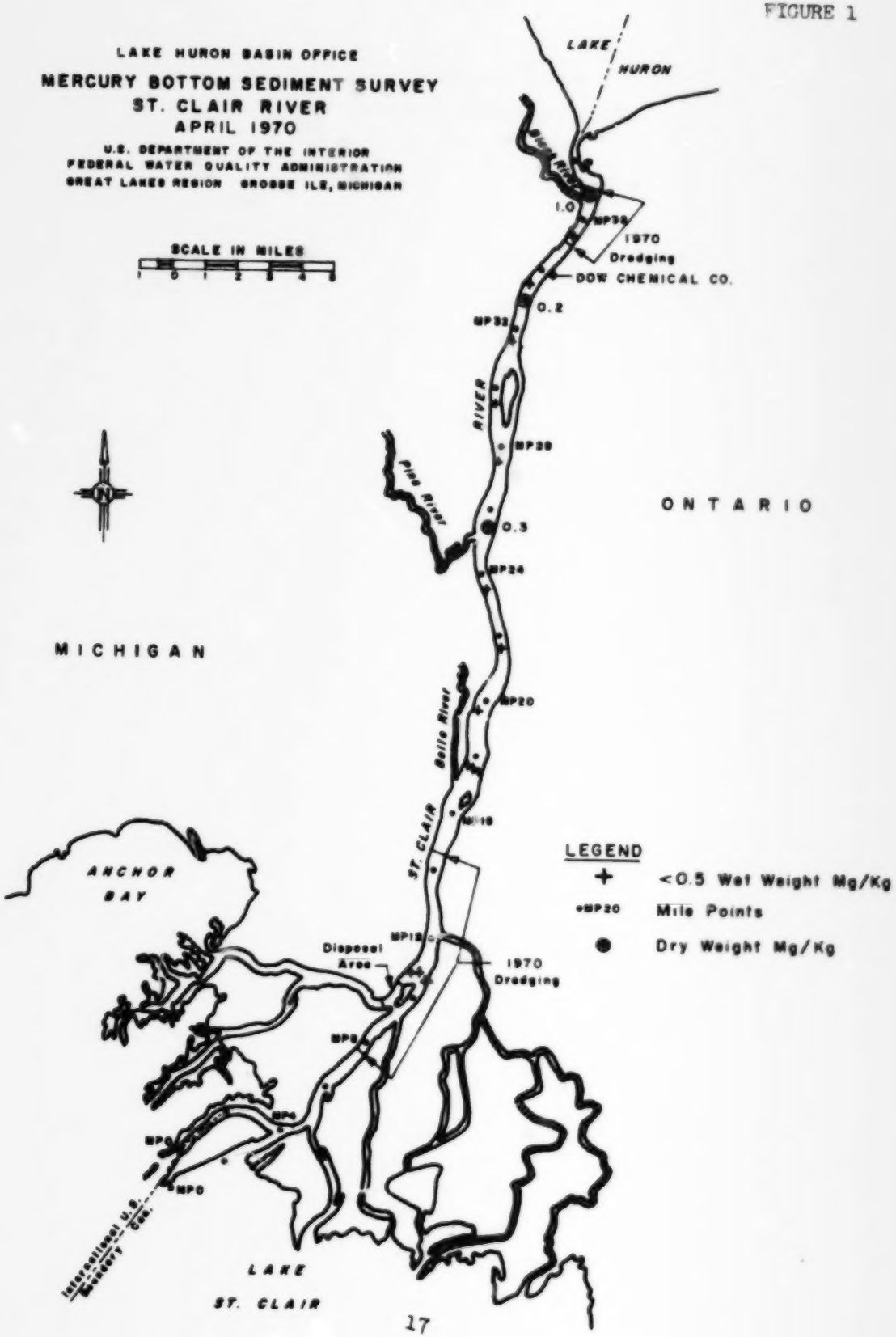

LAKE HURON BASIN OFFICE
MERCURY BOTTOM SEDIMENT SURVEY
ST. CLAIR RIVER
APRIL 1970
U.S. DEPARTMENT OF THE INTERIOR
FEDERAL WATER QUALITY ADMINISTRATION
GREAT LAKES REGION GROSSE ILE, MICHIGAN
SCALE IN MILES
1 0 1 2 3 4 5
LAKE
HURON
1.0
MP36
1970
Dredging
DOW CHEMICAL CO.
0.2
MP32
RIVER
MP28
Pine River
ONTARIO
0.5
MP24
MICHIGAN
Belle River
MP20
ST. CLAIR
MP16
ANCHOR
BAY
MP12
Disposal
Area
1970
Dredging
MP8
MP4
MP2
MP0
International U.S.
Boundary
Line
LAKE
ST. CLAIR
LEGEND
+ <0.5 Wet Weight Mg/Kg
•MP20 Mile Points
● Dry Weight Mg/Kg

Table 2

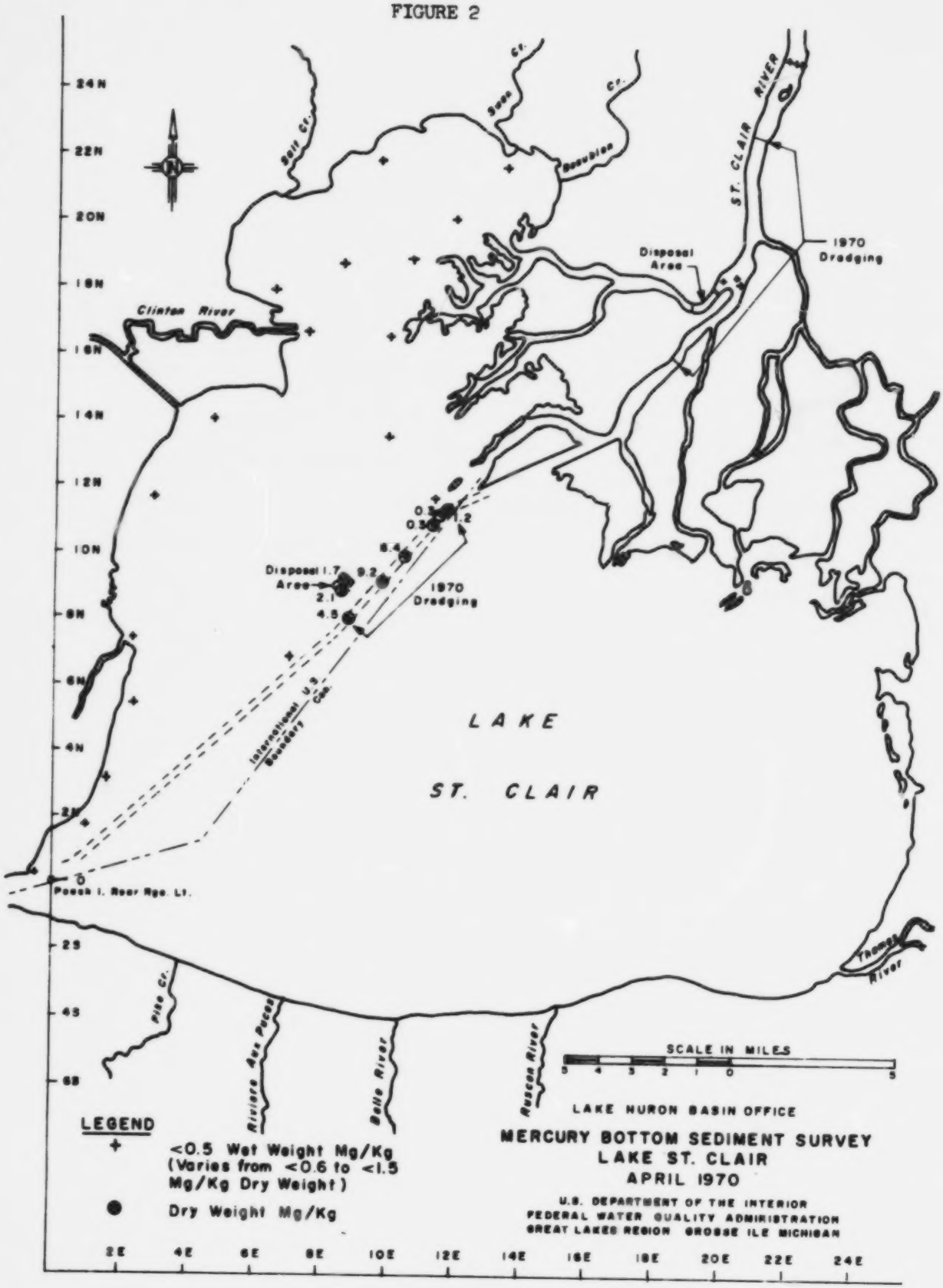
MERCURY SURVEY

Sample Analysis Results

Lake St. Clair

Sample Collection Date	Location Grid Coordinates		Mercury Content Sediment (mg/kg) Wet Basis	Dry Basis	Water (mg/l)
1970					
4/15	18.8N	10.6E	< 0.5		
"	3.8N	4.3E			< 0.005
"	13.5N	9.9E	< 0.5		
"	16.5N	10.0E	< 0.5		
"	16.6N	7.6E	< 0.5		
"	18.7N	8.6E	< 0.5		
"	20.0N	11.9E	< 0.5		
4/21	0.4N	0.4W	< 0.5		
"	1.8N	1.1E	< 0.5		
"	3.2N	1.7E	< 0.5		
"	5.5N	2.5E	< 0.5		
"	7.5N	2.3E	< 0.5		
4/22	6.8N	7.1E	< 0.5		
"	11.2N	11.2E	< 0.5		
"	11.6N	2.9E	< 0.5		
"	13.9N	4.8E	< 0.5		
"	17.8N	6.6E	< 0.5		
"	21.7N	9.6E	< 0.5		
"	21.5N	13.4E	< 0.5		

FIGURE 2


24N
22N
20N
18N
16N
14N
12N
10N
8N
6N
4N
2N
2S
4S
6S
2E
4E
6E
8E
10E
12E
14E
16E
18E
20E
22E
24E
Bell Cr.
Sugar Cr.
Beaubien Cr.
ST. CLAIR RIVER
Clinton River
Disposal Area
1970 Dredging
0.3
0.3
1.2
8.4
9.2
Disposal Area
1.7
2.1
4.5
1970 Dredging
International Boundary
U.S. Can.
LAKE
ST. CLAIR
Peach I. Rear Rge. Lt.
Pine Cr.
Riviere Aux Peches
Belle River
Ruscom River
Thames River
SCALE IN MILES
5 4 3 2 1 0 5
LEGEND
<0.5 Wet Weight Mg/Kg
(Varies from <0.6 to <1.5
Mg/Kg Dry Weight)
Dry Weight Mg/Kg
LAKE HURON BASIN OFFICE
MERCURY BOTTOM SEDIMENT SURVEY
LAKE ST. CLAIR
APRIL 1970
U.S. DEPARTMENT OF THE INTERIOR
FEDERAL WATER QUALITY ADMINISTRATION
GREAT LAKES REGION GROSSE ILE MICHIGAN

UPPER DETROIT RIVER (LAKE ST. CLAIR TO GRASSY ISLAND)

Sampling of the upper Detroit River and lower Rouge River began on March 26, 1970, and continued to April 24. Sixteen sediment and six water samples were obtained, as indicated in Tables 3 and 4, and shown on Figures 3 and 4. Mercury was detected in sediments along the U. S. shoreline at boat ramps and in other backwater areas. Values ranged from less than the measurable level near the headwaters to 2.0 mg/kg downstream from the Rouge River. Concentrations in sediments around Grassy Island and upper Fighting Island were less than the measurable limit.

Table 3

MERCURY SURVEY

Sample Analysis Results

Upper Detroit River
(upstream from the Rouge River)

Sample Collection Date	Location		Mercury Content		
			Sediment (mg/kg)		Water
	River Mile	Feet from U.S. Shore	Wet Basis	Dry Basis	(mg/l)
1970					
3/26	26.8	700	< 0.5		< 0.01
3/30	30.8	500			< 0.01
"	30.8	1000			< 0.01
"	30.7	500			< 0.01
"	30.7	980			< 0.01
4/14	29.3	1600	< 0.5		
4/23	30.8	0	< 0.5		
"	29.4	0	< 0.5		
"	27.4	3300	0.6	0.9	
"	26.2	2300	< 0.5		
"	25.7	0	0.9	1.2	
"	23.8	100	0.5	0.7	
"	22.3	0	0.6	1.2	
"	21.1	0	0.7	1.4	

FIGURE 3

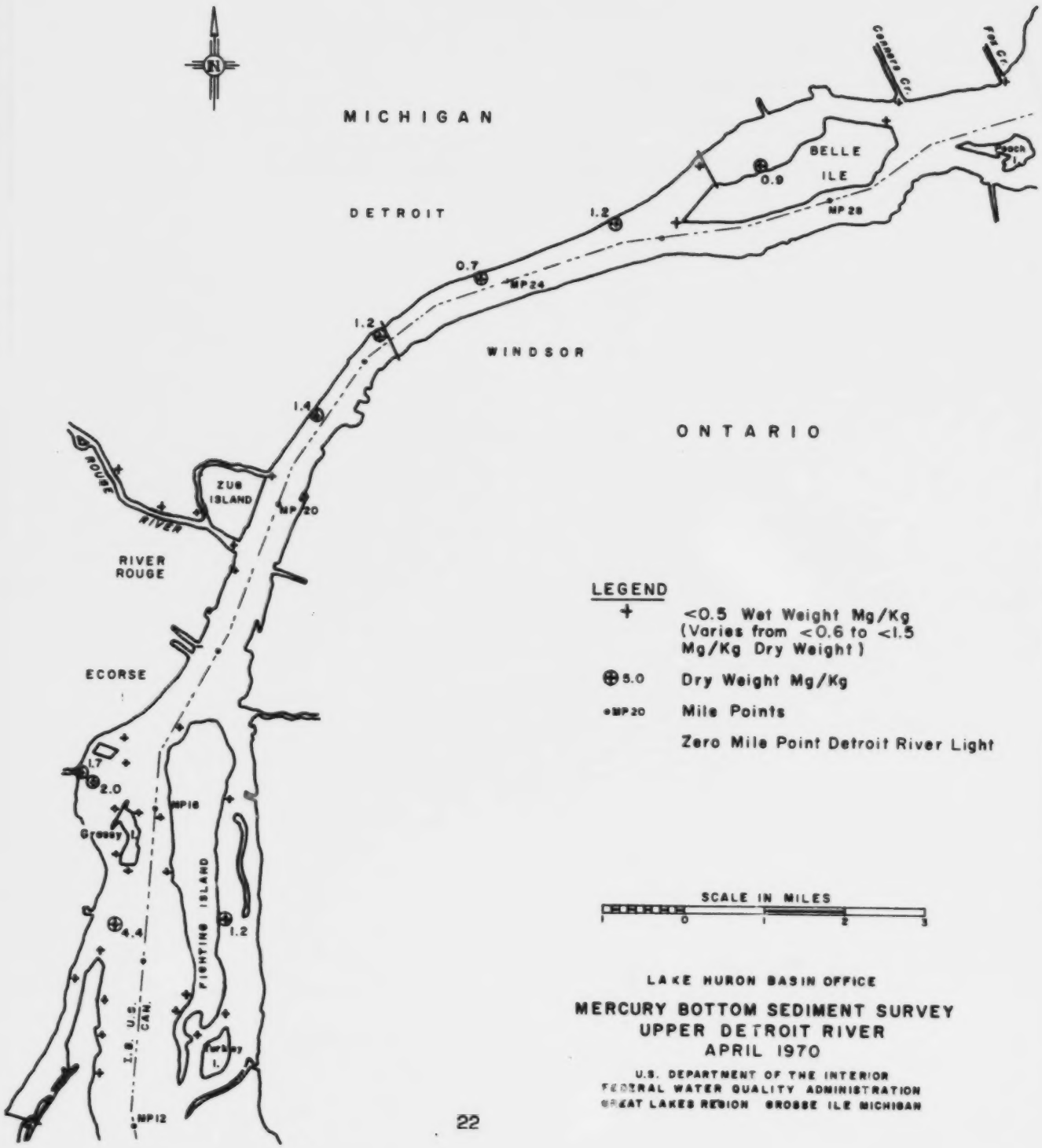

MICHIGAN
DETROIT
WINDSOR
ONTARIO
BELLE ILE
0.9
1.2
MP 28
0.7
MP24
1.2
1.4
ZUG ISLAND
MP 20
ROUGE RIVER
RIVER ROUGE
ECORSE
1.7
2.0
MP18
4.4
1.2
FIGHTING ISLAND
U.S. CAN.
MP12
LEGEND
+ <0.5 Wet Weight Mg/Kg (Varies from <0.6 to <1.5 Mg/Kg Dry Weight)
5.0 Dry Weight Mg/Kg
MP20 Mile Points
Zero Mile Point Detroit River Light
SCALE IN MILES
0 1 2 3
LAKE HURON BASIN OFFICE
MERCURY BOTTOM SEDIMENT SURVEY
UPPER DETROIT RIVER
APRIL 1970
U.S. DEPARTMENT OF THE INTERIOR
FEDERAL WATER QUALITY ADMINISTRATION
GREAT LAKES REGION GROSSE ILE MICHIGAN

Table 4

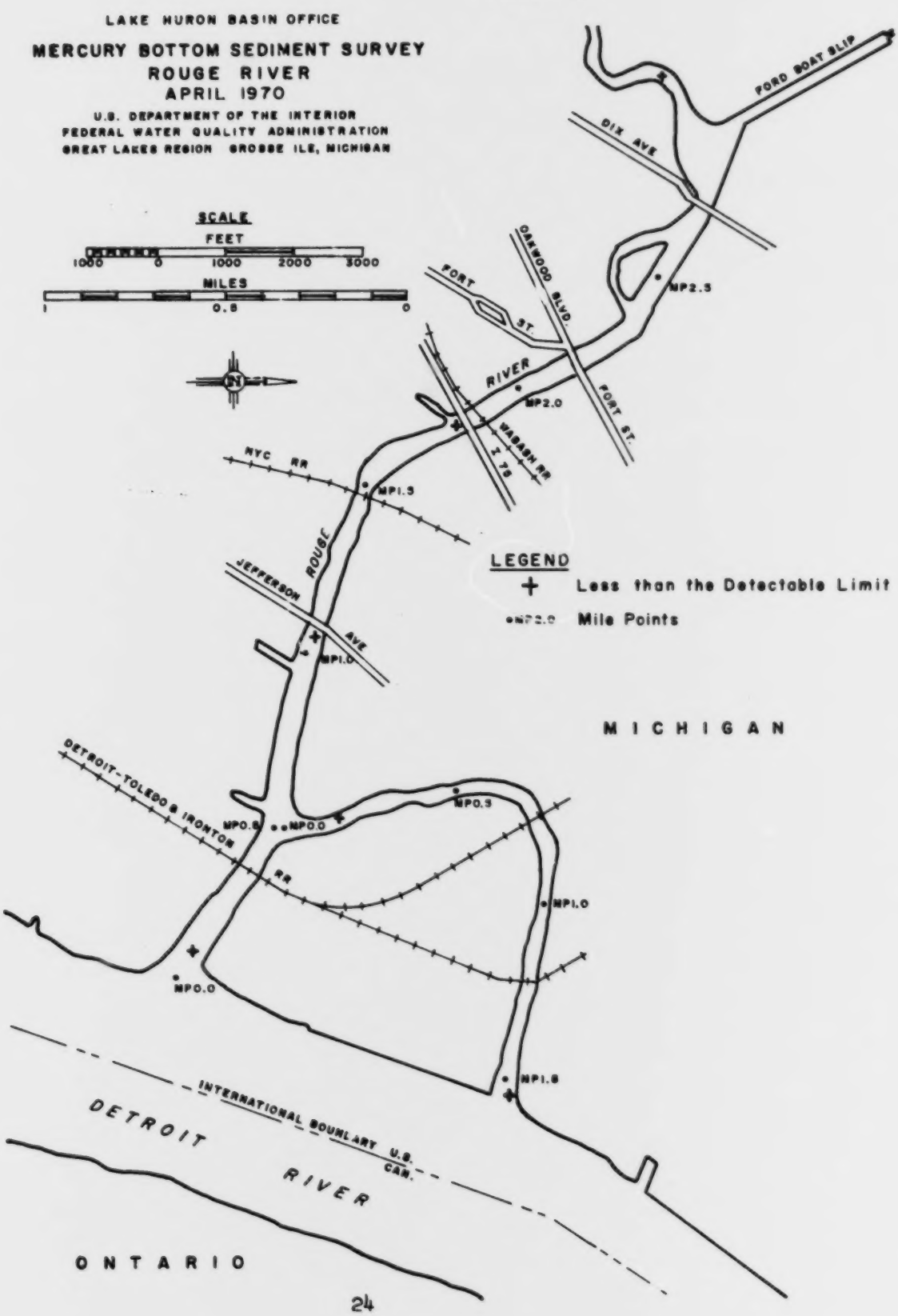
MERCURY SURVEY

Sample Analysis Results

Rouge River

Sample Collection Date	River Mile	Mercury Content Sediment (mg/kg) Wet Basis	Sediment (mg/kg) Dry Basis	Water (mg/l)
1970				
3/26	1.1	< 1.0		< 0.01
4/23	.3 Old Channel	< 0.5		
"	1.5 Old Channel	< 0.5		
4/24	1.8	< 0.5		
"	3.1	< 0.5		
"	.1	< 0.5		

FIGURE 4


LAKE HURON BASIN OFFICE
MERCURY BOTTOM SEDIMENT SURVEY
ROUGE RIVER
APRIL 1970
U.S. DEPARTMENT OF THE INTERIOR
FEDERAL WATER QUALITY ADMINISTRATION
GREAT LAKES REGION GROSSE ILE, MICHIGAN
SCALE
FEET
1000 0 1000 2000 3000
MILES
1 0.5 0
N
FORD BOAT SLIP
DIX AVE
OAKWOOD BLVD.
FORT ST.
MP2.5
RIVER
MP2.0
FORT ST.
WABASH RR
I 75
NYC RR
MP1.5
ROUGE
JEFFERSON AVE
MP1.0
LEGEND
+ Less than the Detectable Limit
Mile Points
MICHIGAN
DETROIT-TOLEDO & IRONTON RR
MP0.5
MP0.0
MP0.3
MP1.0
MP0.0
INTERNATIONAL BOUNDARY U.S. CAN.
MP1.5
DETROIT RIVER
ONTARIO

LOWER DETROIT RIVER (GRASSY ISLAND TO MOUTH)

In the portion of the Detroit River from Grassy Island to the mouth at Lake Erie, 78 sediment and 23 water samples were collected between March 26 and April 16, as shown in Tables 5 and 6 and Figure 5. The highest levels of mercury occurred in the bottom muds of the Trenton Channel downstream from the Wyandotte Chemicals Corp. South Works, in a narrow strip of from 20 to 100 feet along the western shore. Concentrations along the east shore of the channel near Grosse Ile were less than the measurable limit of 0.5 mg/kg. Mercury in the sediments indicates that the Wyandotte Chemicals' mercury discharge hugs the western shore of the Trenton Channel, depositing mercury in the bottom muds along shore. No mercury was present around Wyandotte Chemicals' waste beds, located on the northern tip of Grosse Ile. However, one sample collected between Grassy Island and Grosse Ile contained 4.4 mg/kg mercury.

Mercury contamination in sediments was present along shore as far as Lake Erie. In addition to high values near Wyandotte Chemicals, one sample with 26.0 mg/kg dry weight was collected at the northern tip of Horse Island (Gibralter, Michigan) at mile point 6.7.

Of the four samples collected at the southern end of Fighting Island, one contained 1.2 mg/kg mercury, and the others

contained trace amounts, but all were below the measurable limit. Wyandotte Chemicals waste lagoons are located on Fighting Island.

The only mercury measurable in four samples in Canadian sediments was near the shore at mile point 3.9 (0.6 mg/kg).

As indicated in the tables, the levels of mercury in all water samples but one were below the measurable limit of 0.01 mg/l. One sample collected 300 feet downstream from Wyandotte Chemicals outfall W23 (RM 13.3) contained 0.03 mg/l. The effluent was diluted by Detroit River water so mercury was not measurable further downstream from the discharge point.

Table 5

MERCURY SURVEY

Sample analysis Results

Lower Detroit River
(below the mouth of the Rouge River
excluding the Trenton Channel)

Sample Collection Date	Location		Mercury Content		
			Sediment (mg/kg)		Water
	River Mile	Ft. from U.S. Shore	Wet Basin	Dry Basis	(mg/l)
1970					
3/27	13.5	9400	< 1.0		< 0.01
"	13.3	8850	< 0.5		
"	8.4	17,700	< 0.5		
"	3.9	15,000	< 0.5		< 0.01
"	3.9	19,000	0.5	0.6	< 0.01
3/30	3.9	15,000			< 0.01
"	3.9	19,000			< 0.01
4/6	5.9	13,500	< 1.0		
4/8	14.2	1400	< 0.5		
"	13.7	2100	< 0.5		
"	13.3	2400	< 0.5		
"	12.7	3200	< 0.5		
"	15.3	1500	< 0.5		
"	16.0	2300	< 0.5		
4/14	14.6	1300	1.1	4.4	
"	16.0	5500	< 0.5		
"	16.3	500	0.7	2.0	
"	16.4	0	0.5	1.7	
"	16.5	2900	< 0.5		
"	16.7	1000	< 0.5		
"	18.1	0	< 0.5		
"	19.0	0	< 0.5		
4/16	16.3	9950	< 0.5		
"	14.8	8200	0.7	1.2	
"	13.5	7200	< 0.5		
"	13.6	7700	< 0.5		
"	15.3	4300	< 0.5		
"	17.1	2500	< 0.5		
"	16.0	3700	< 0.5		
"	15.4	1000	< 0.5		

Table 6

MERCURY SURVEY

Sample Analysis Results

Detroit River-Trenton Channel Area

Sample Collection Date	Location		Mercury Content		
			Sediment (mg/kg)		Water
	River Mile	Feet from U.S. Shore	Wet Basis	Dry Basis	(mg/l)
1970					
3/26	8.7	80	<1.0		< 0.01
3/27	13.1	20	28.0	86.0	
"	13.4	20	13.0	21.0	
"	13.2	20	10.0	16.0	
"	12.4	20	4.0	8.0	
"	3.9	2500	4.9	11.0	< 0.01
"	3.9	6500	< 0.5		< 0.01
3/30	3.9	2500			< 0.01
"	3.9	6500			< 0.01
3/31	13.2	20			< 0.01
"	13.1	20			< 0.01
"	13.3	20			0.03
4/1	13.4	20	2.0	3.0	
"	13.4	100	< 2.0		
"	13.2	20	5.0	7.0	
"	13.2	100	< 2.0		
"	13.1	20	25.0	82.0	
"	13.1	100	6.0	10.0	
"	13.1	200	< 2.0		
"	12.4	20	4.0	10.0	
"	12.4	200	< 2.0		
"	12.4	800	< 2.0		
"	12.4	1000	< 2.0		
"	13.9	0	< 2.0		
"	12.0	0	6.0	14.0	
4/3	13.2	20			<0.01
"	13.1	20			<0.01
"	12.4	20			<0.01
"	13.3	20			<0.01
"	12.8	20			<0.01
"	12.0	20			<0.01
"	11.3	50			<0.01
"	10.5	50			<0.01
"	9.8	50			<0.01
"	8.7	80			<0.01

Table 6

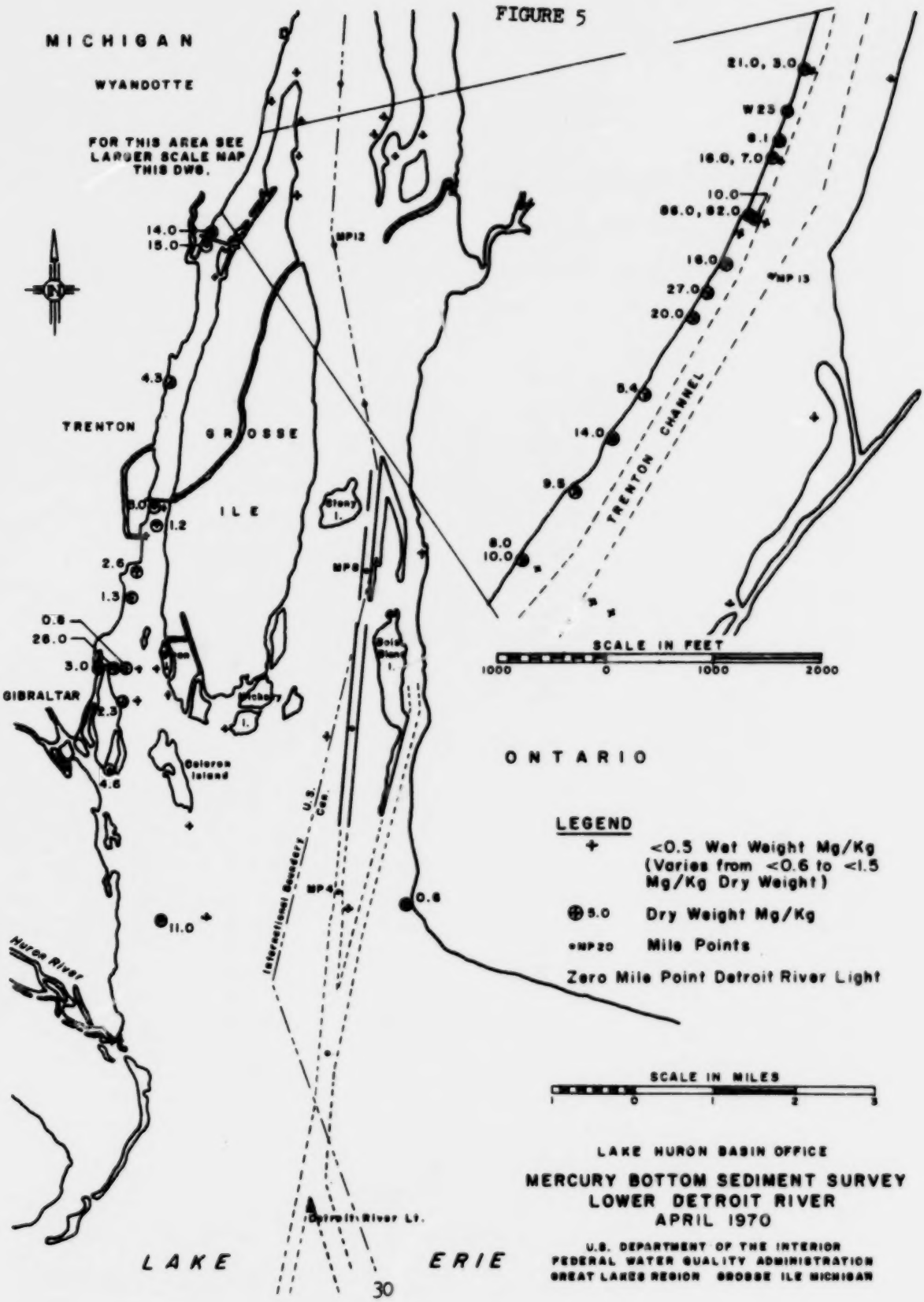
MERCURY SURVEY

Sample Analysis Results

Detroit River-Trenton Channel Area (cont.)

Sample Collection Date	Location		Mercury Content Sediment (mg/kg)		Water (mg/l)
	River Mile	Feet from U.S. Shore	Wet Basis	Dry Basis	
1970					
4/6	8.7	80	1.9	5.0	
"	8.7	1240	< 1.0		
"	10.2	0	2.8	4.3	
"	7.9	300	1.7	2.6	
"	5.4	600	2.2	4.6	
"	4.7	6200	< 1.0		
"	5.8	7200	< 1.0		
"	12.0	20	7.1	15.0	
4/7	7.6	100	1.0	1.3	
"	6.7	150	11.0	26.0	
"	6.3	1200	< 1.0		
"	6.3	3400	< 1.0		
4/8	11.6	1150	< 0.5		
"	12.0	1850	< 0.5		
"	12.5	1850	< 0.5		
"	12.8	1500	< 0.5		
"	13.4	850	< 0.5		
4/16	8.6	600	0.9	1.2	
4/17	6.7	100	0.9	3.0	
"	6.7	1000	0.6	0.8	
"	6.7	2000	< 0.5		
"	6.7	3000	< 0.5		
"	6.3	150	1.5	2.3	
4/24	8.3	0	< 0.5		
4/26	13.0	20	< 0.5		
"	13.0	20	4.9	16.0	
"	12.9	20	12.0	27.0	
"	12.8	20	9.7	20.0	
"	12.7	20	2.4	5.4	
"	12.6	20	5.6	14.0	
"	12.5	20	4.3	9.5	
"	13.2	20	5.7	8.1	

FIGURE 5



LAKE HURON BASIN OFFICE

MERCURY BOTTOM SEDIMENT SURVEY
LOWER DETROIT RIVER
APRIL 1970

U.S. DEPARTMENT OF THE INTERIOR
FEDERAL WATER QUALITY ADMINISTRATION
GREAT LAKES REGION GROSSE ILE MICHIGAN

WESTERN BASIN OF LAKE ERIE, INCLUDING THE RAISIN AND MAUMEE RIVERS

The sampling of Lake Erie began on April 6, 1970, with bottom sediments collected at two stations near the mouth of the Huron River (Figure 6). From April 6 to April 27, 44 bottom sediment stations were sampled. Samples were collected in western Lake Erie, west of Pelee Island, with the majority of samples collected near the mouths of Michigan tributaries. Based on the measurable limit of 0.5 mg/kg wet weight, mercury was present at 16 of the 44 stations, although traces were present at most of the other stations (Table 7).

The Raisin River was sampled on two different dates at three stations (Figure 6). Traces of mercury were present; however, all results were less than the measurable limit (Table 8).

The Maumee River was sampled on April 17 at six stations (Figure 7), and traces of mercury were present at most stations; however, all results were less than the measurable limit (Table 9).

The 16 stations where mercury was present are located in the deepwater areas of the western basin of Lake Erie from the mouth of the Detroit River southward and eastward. Since shoreline and minor tributary samples did not contain appreciable amounts of

mercury, the Detroit River appears to be the principal source, with mercury being deposited in the deeper quiescent parts of the lake.

Table 7

MERCURY SURVEY

Sample Analysis Results

Lake Erie

Sample Collection Date 1970	Location Grid Coordinates		Mercury Content Sediment (mg/kg) Wet Basis	Sediment (mg/kg) Dry Basis	Water (mg/l)
4/6	2.2N	2.6W	< 1.0		
"	2.0N	2.4W	< 1.0		
4/7	0.7N	1.3W	1.0	1.8	
"	0.0N	0.6W	1.0	1.8	
"	1.3S	4.2W	< 0.5		
"	2.0S	3.2W	< 0.5		
"	2.9S	2.2W	< 1.0		
"	3.7S	4.8W	< 0.5		
4/10	2.8S	5.8W	< 0.5		
"	4.3S	8.3W	< 0.5		
"	5.0S	6.4W	< 0.5		
"	5.4S	9.5W	< 0.5		
"	9.6S	11.6W	0.6	0.8	
4/14	17.4S	2.4E	0.5	1.6	
"	0.5N	3.2E	< 0.5		
"	5.1S	2.0W	0.5	1.0	
"	8.7S	2.9E	< 0.5		
"	9.4S	5.7W	0.8	1.8	
"	10.7S	6.7E	< 0.5		
"	16.5S	9.4W	< 0.5		
"	17.4S	5.8W	< 0.5		
4/15	11.2S	10.3W	< 0.5		
"	1.3S	2.9W	0.8	1.0	
"	4.3S	4.9W	< 0.5		
"	8.6S	8.1W	< 0.5		
"	14.8S	13.1W	< 0.5		
"	21.3S	7.1W	< 0.5		
"	23.6S	3.5W	< 0.5		
"	24.8S	1.2E	< 0.5		
4/25	6.0S	0.0	0.7	1.1	
"	10.0S	0.0	0.6	1.7	
"	14.0S	0.0	0.6	2.1	
"	14.0S	8.0E	< 0.5		
"	20.0S	0.0	0.5	1.7	
"	20.0S	8.0E	< 0.5		
"	24.0S	14.0E	< 0.5		
4/27	2.4N	0.4E	1.0	1.8	
"	0.3N	0.0E	1.0	2.1	
"	4.0S	8.0E	0.9	2.7	
"	4.0S	14.0E	0.5	1.3	
"	4.0S	20.0E	0.5	1.5	
"	14.0S	20.0E	< 0.5		
"	20.0S	20.0E	< 0.5		
"	16.0S	14.0E	< 0.5		

Table 8

MERCURY SURVEY

Sample Analysis Results

River Raisin

Sample Collection Date	Location		Mercury Content Sediment (mg/kg)		Water (mg/l)
	Grid Coordinates	River Mile	Wet Basis	Dry Basis	
1970					
4/10	7.6S 9.8W	-0.5	< 0.5		
3/30	Consolidated Paper(S) W154	1.7	< 0.5		< .01
3/30	Mason Run at Ford Bridge W171	1.3-0.1	< 0.5		< .01

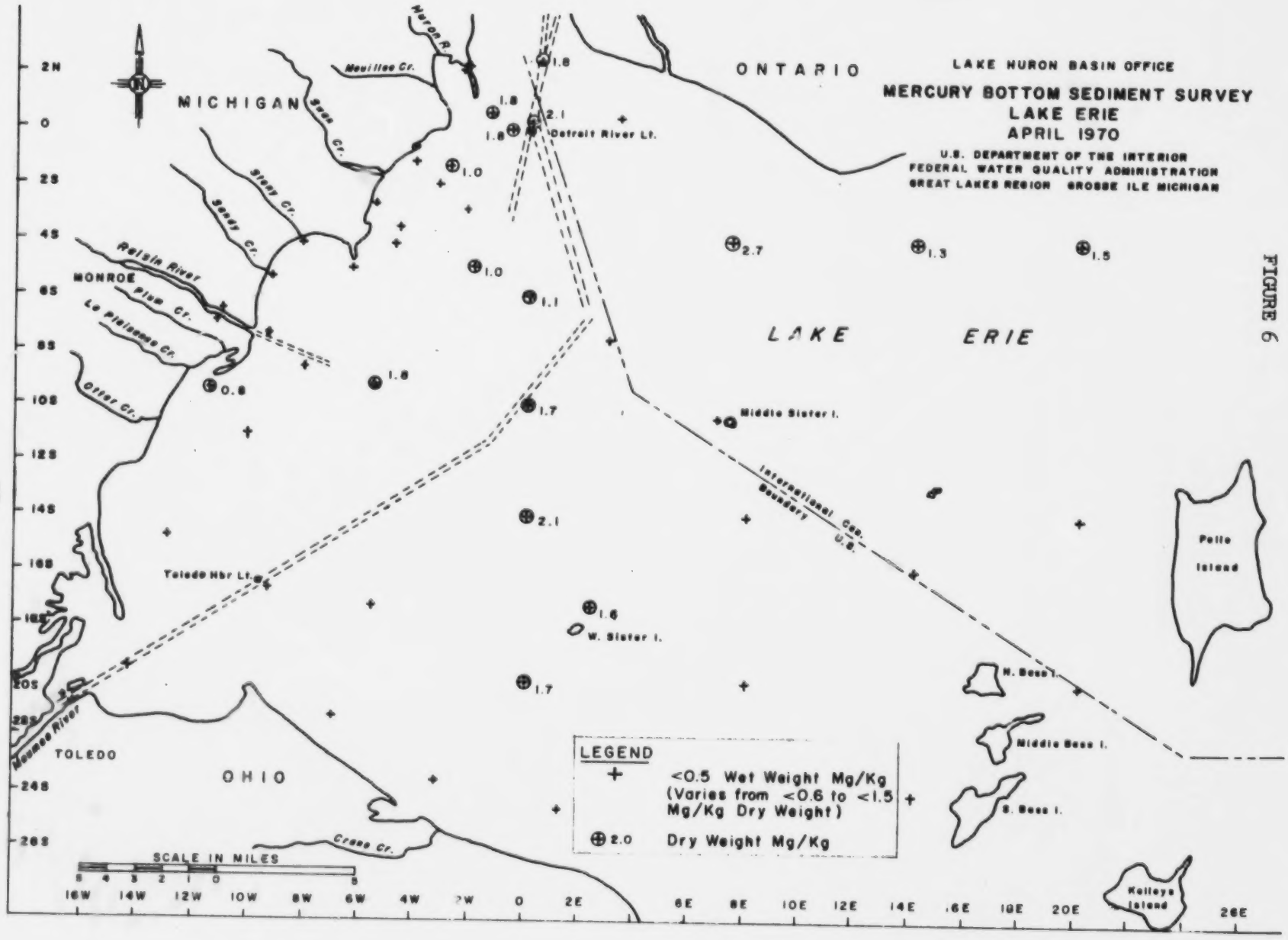

LAKE HURON BASIN OFFICE
MERCURY BOTTOM SEDIMENT SURVEY
LAKE ERIE
APRIL 1970
U.S. DEPARTMENT OF THE INTERIOR
FEDERAL WATER QUALITY ADMINISTRATION
GREAT LAKES REGION GROSSE ILE MICHIGAN
MICHIGAN
ONTARIO
OHIO
LAKE ERIE
TOLEDO
MONROE
Huron R.
Mouillee Cr.
Swan Cr.
Stony Cr.
Sandy Cr.
Raisin River
Plum Cr.
La Plaisance Cr.
Otter Cr.
Detroit River Lt.
Middle Sister I.
International Con. Boundary U.S.
Toledo Hbr Lt.
W. Sister I.
N. Bass I.
Middle Bass I.
S. Bass I.
Pelee Island
Kelleys Island
Maumee River
Crane Cr.
LEGEND
<0.5 Wet Weight Mg/Kg (Varies from <0.6 to <1.5 Mg/Kg Dry Weight)
2.0 Dry Weight Mg/Kg
SCALE IN MILES
5 4 3 2 1 0 5
16W 14W 12W 10W 8W 6W 4W 2W 0 2E 6E 8E 10E 12E 14E 16E 18E 20E 26E
2N 0 2S 4S 6S 8S 10S 12S 14S 16S 18S 20S 22S 24S 26S

FIGURE 6

Table 9

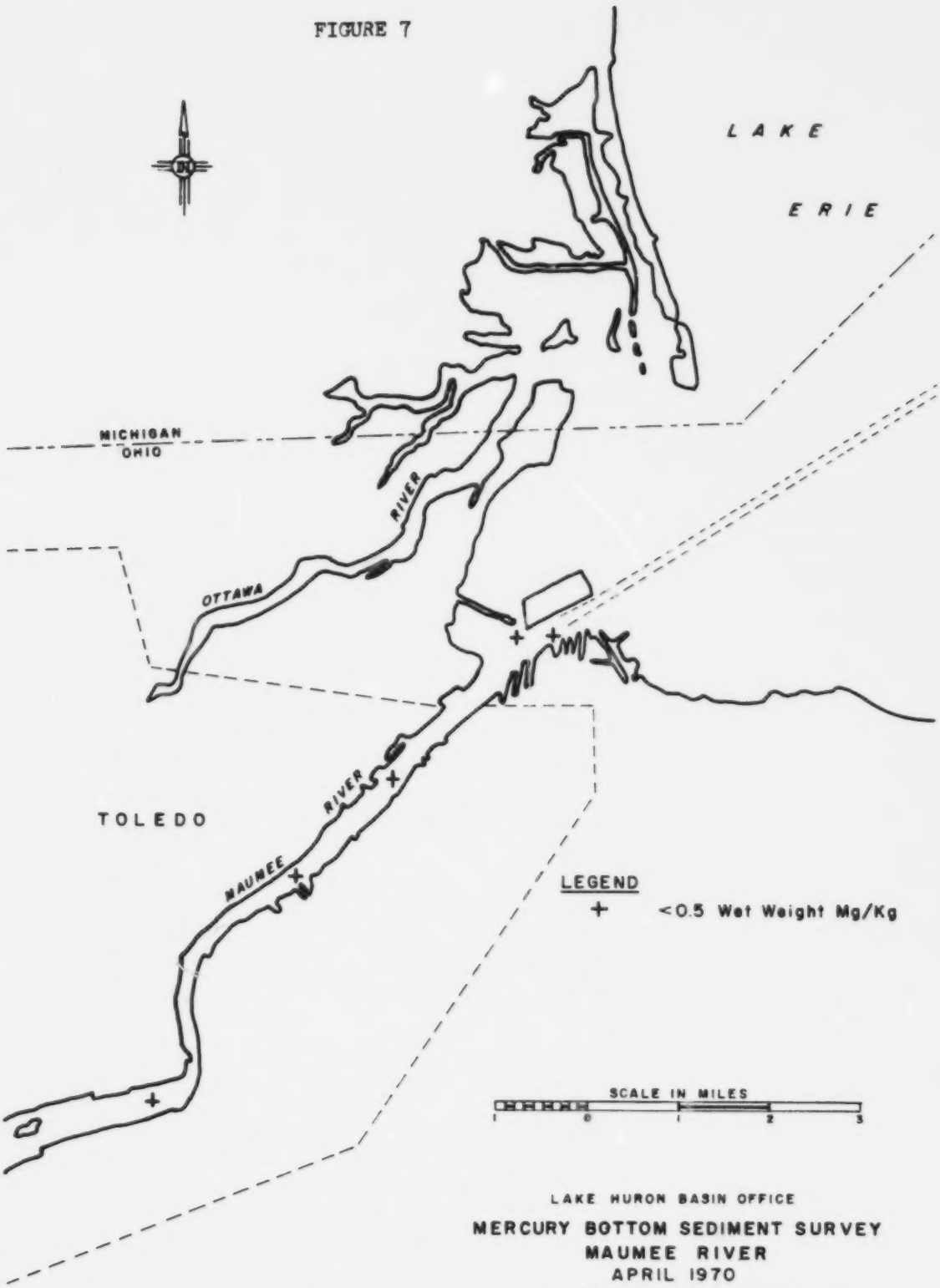
MERCURY SURVEY

Sample Analysis Results

Maumee River

Sample Collection Date	Location		River Mile	Mercury Content Sediment (mg/kg) Wet Basis	Dry Basis	Water (mg/l)
1970						
4/17			0.5	< 0.5		
"			0.0	< 0.5		
"			2.1	< 0.5		
"			5.1	< 0.5		
"			6.9	< 0.5		
"	19.6S	14.5W		< 0.5		

FIGURE 7



LAKE HURON BASIN OFFICE

MERCURY BOTTOM SEDIMENT SURVEY
MAUMEE RIVER
APRIL 1970

U.S. DEPARTMENT OF THE INTERIOR
FEDERAL WATER QUALITY ADMINISTRATION
GREAT LAKES REGION GROSSE ILE, MICHIGAN

MERCURY ANALYSES IN THE EASTERN PORTION OF THE LAKE ERIE BASIN

As part of its mercury investigations in the Lake Erie Basin, the Federal Water Quality Administration-Lake Erie Basin Office analyzed bottom sediments from the downstream portions of south shore tributaries and from the lake bottom. Tables 10 and 11 include results from the sediment and water analyses to 5-12-70 except those made at the Detrex Chemical Corp. plant. Detrex analyses are listed in a special report on that plant (Appendix II).

At the Lake Erie Basin Office the lower limit of measurability of mercury in sediments is 1 mg/kg and in water 0.002 mg/l.

The states of Ohio, Pennsylvania, and New York report no measurable mercury in any water supply intakes within this area.

Table 10

LAKE ERIE BASIN OFFICE

MERCURY ANALYSES - WATER

Station No.	Location	Date 1970	Mercury* mg/l
12	Diamond Shamrock, Painesville		
	Influent	4/10	<0.002
	Hydro discharge to Grand River	4/10	0.010
	North sewer to Lake Erie	4/10	<0.002
14	1.59 mi. Ashtabula River (Norfolk and Western RR bridge)	4/17	<0.002
15	1.95 mi. Fields Brook (Columbus Rd. bridge)	4/17	<0.002
	Euclid, Ohio STP	5/11	0.004
	Cleveland Southerly STP	5/12	0.004
	Cleveland Westerly STP	5/12	0.003
	Cleveland Easterly STP	5/6	< 0.002
	Mile 1.0 West Branch Ashtabula River 200' downstream from titanium plant	5/5	< 0.002
	General Electric, Nela Park, Cleveland - Discharge 3 gals every two weeks		1.060

*0.01 mg/l is the lowest sensitivity of test

Table 11

LAKE ERIE BASIN OFFICE

MERCURY ANALYSES - SEDIMENT

Dry Weight Basis

Station No.	Location	Date	Mercury* mg/kg
1	0.53 mi. Portage River (Rt. 2 bridge)	4/14	< 1
2	0.0 mi. Sandusky River	4/14	< 1
3	Tributaries emanating from NASA-Plumbrook		
	PB-1 (Plum Brook)	4/10	< 1
	PB-2 (No Name Creek)	4/10	< 1
	PB-3 (East Branch, Pipe Creek)	4/10	< 1
4	0.61 mi. Black River (Rt. 2 bridge)	4/13	8
5	8.13 mi. Rocky River	4/22	< 1
6	10.0 mi. Rocky River (NASA - Brookpark)	4/14	< 1
7	4.27 mi. Cuyahoga River (Norfolk & Western RR Bridge)	4/10	< 1
8	C33-8 (100 ft. North of Cleveland Easterly STP outfall)	4/13	4
9	D24-1 (50 ft. North of E. 222nd St - Babbitt Rd. sewer outfalls. Euclid, O.)	4/13	2
10	Tributary to Chagrin River (General Biochemical plant)		
	#1 (200 ft. downstream from plant outfall)	4/10	< 1
	#2 (at plant outfall)	4/10	< 1
11	2.85 mi. Grand River (St. Clair St. bridge)	4/10	< 1
13	0.76 mi. Ashtabula River (East 5th St. bridge)	4/15	2
15	1.95 mi. Fields Brook (Columbus RR bridge)	4/10	< 1
16	No Name Ditch East of Ashtabula (Rt 531 bridge)	4/13	8
17	J41-1 (Presque Isle Bay)	4/20	< 1

* 1 mg/kg is the lowest sensitivity of test

Table 11

LAKE ERIE BASIN OFFICE (cont'd)

MERCURY ANALYSES - SEDIMENT

Dry Weight Basis

Station No.	Location	Date	Mercury* mg/kg
18	G33-12 (20 ft. north of Detrex-Linde lakefront outfall)	4/20 4/23	< 1 < 1
19	G33-13 (80 ft. north of Detrex-Linde lakefront outfall)	4/20 4/23	< 1 < 1
20	123-2 (6 mi. north of Ashtabula)	4/22	< 1
21	H34-2 (6,600 ft., 38°T from Detrex-Linde outfall)	4/22	< 1
22	H34-1 (7,000 ft., 35°T from Detrex-Linde outfall)	4/22	< 1
23	H33-7 (5,600 ft., 20°T from Detrex-Linde outfall)	4/22	< 1
24	5,000 ft. north of Detrex-Linde outfall (H33-8)	4/23	< 1
25	3 mi., 56°T from Detrex-Linde outfall (H34-5)	4/23	< 1
26	4-3/4 mi., 61°T from Detrex-Linde outfall (H34-6)	4/23	< 1
27	2 miles ENE of Conneaut (H36-20)	4/24	< 1
28	Mouth of Ashtabula River (A-4)	4/28	< 1
29	0.96 miles Ashtabula River (A-3)	4/28	< 1
30	600 ft. north of mouth of Grand River (G-5)	4/28	< 1
31	0.50 miles Grand River (G-4)	4/28	< 1
32	Mouth of Black River (B-4)	4/28	< 1
33	1.0 miles Black River (B-3)	4/28	< 1

* 1 mg/kg is the lowest sensitivity of test

Table 11

LAKE ERIE BASIN OFFICE (concl'd)

MERCURY ANALYSES - SEDIMENT

Dry Weight Basis

Station No.	Location	Date	Mercury* mg/kg
34	37-1/4 mi., 7°T from Cleveland (123-1) Core length		
	0-4 inches	8/20/69	< 1
	4-8 inches	8/20/69	< 1
	4-12 inches	8/20/69	< 1
	16-20 inches	8/20/69	< 1
35	Composite of benthic organisms obtained from Kelleys Island Shoal and Starve Island Reef	4/15	< 1
	RM 0.0 Buffalo River	5/6/70	4
	RM 4.3 Buffalo River	5/6/70	1
	RM 0.0 Maumee River	4/28/70	< 1
	RM 1.5 Maumee River	4/28/70	< 1
	S-2 Sandusky Bay - 3 miles 310° true from Sandusky Court House	4/29/70	< 1
	S-7 Sandusky Bay - 1.2 miles 10° true from Sandusky Court House	4/29/70	< 1
	RM 0.4 Cuyahoga River	4/29/70	< 1
	C-6 400 feet NW of Cuyahoga River Mouth	4/29/70	< 1

* 1 mg/kg is the lowest sensitivity of test

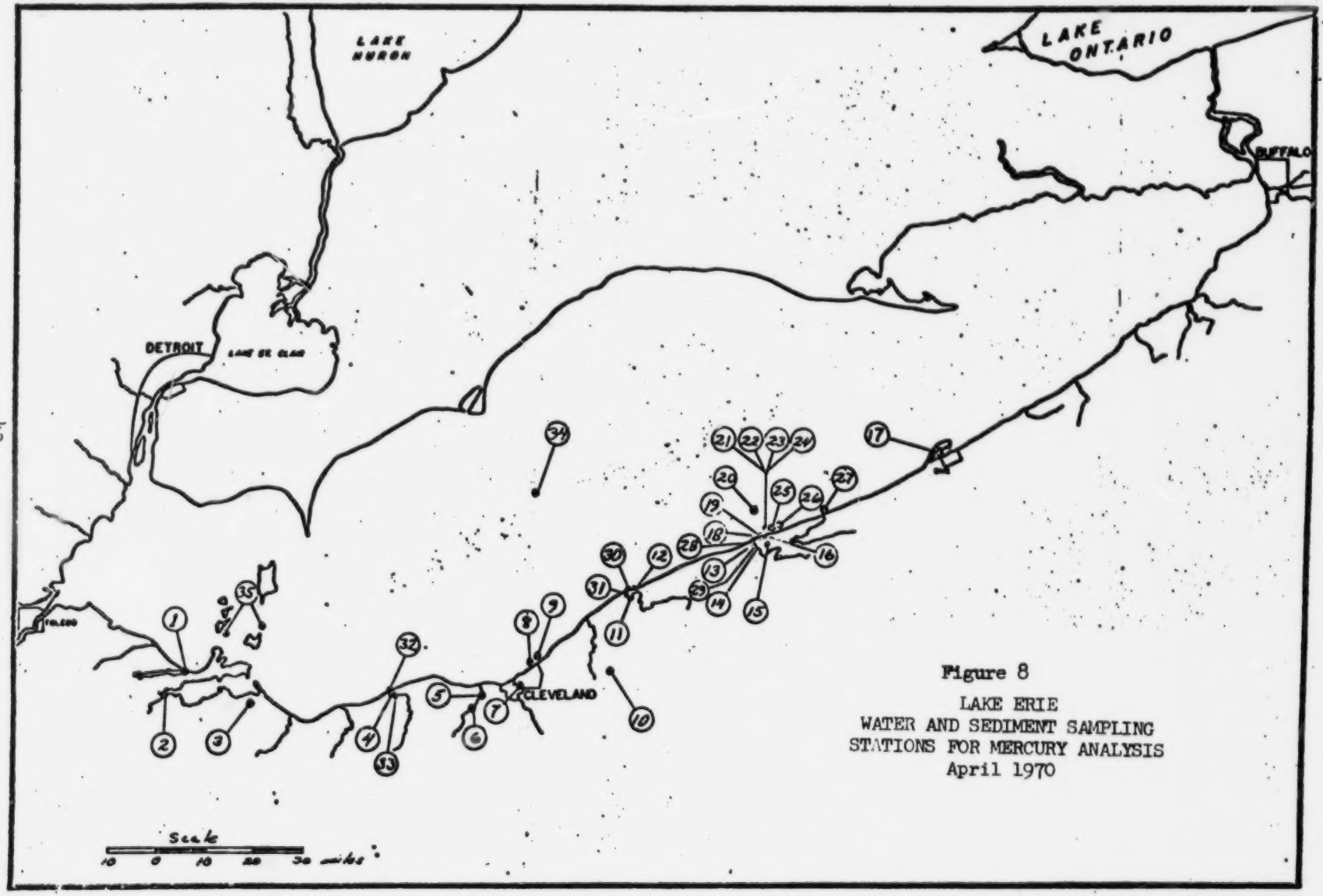


Figure 8

LAKE ERIE
WATER AND SEDIMENT SAMPLING
STATIONS FOR MERCURY ANALYSIS
April 1970

HEAVY METALS IN THE LAKE ERIE BASIN

As part of the investigations in the Lake Erie Basin, the FWQA, National Field Investigations Center analyzed bottom sediments from various shore areas and tributaries. The results of analyses for ten heavy metals are listed in Table 12 and the sample locations are shown on Figures 9, 10, and 11. Stations were selected in the mouth of tributaries and immediately off-shore.

Heavy metals are toxic to aquatic bottom organisms and fish when present in sufficient concentrations. Combinations of some of these metals such as copper and zinc have a total toxicity greater than the sum of the toxicities of each metal taken independently. Metals such as iron oxides precipitate in water and may blanket the bottom and smother bottom organisms. Toxic metals in bottom muds can be made available to the overlying water by physical, chemical or biological means. Metals may re-enter the overlying water by scouring of the stream bed because of velocity increases, by wave action, or other water turbulences. These metals may also be resolubilized by the waterbody dependent upon environmental conditions such as pH, temperature and concentrations of other metals present. Some of these metals may also be detrimental to aquatic organisms when concentrated in the food web.

SEDIMENTS

DRY WEIGHT BASIS

Table 12

National Field Investigations Center
Office of Enforcement & Standards Compliance, FWQA

SAMPLE DESIGNATION	Mg mg/kg	Cr mg/kg	Pb mg/kg	Ni mg/kg	Hg mg/kg
19747 -- 5/6/70 Detroit River Lt. 29	18,800	30	59	20	1.4
19748 -- 5/6/70 Detroit River (Lake Erie) Detroit River Light (RM - 0.0)	22,400	190	160	100	2.9
19749 -- T.83 Monroe, Raisin River Turning Basin (RM - 1.6)	14,400	60	150	50	< 1.0
19750 -- Monroe Navigation Channel B-7 Lake Erie 8.1 S - 8.7 W	14,900	200	150	100	3.0
19751 -- 19.6S 14.5 W-Hg 33-Lake Erie, Toledo, (Lt. 38-BC 37) Mouth Maumee River	15,000	24	34	40	< 1.0
19752 -- Hg 36, Second R R Bridge, Maumee River (RM - 2.1)	12,600	100	140	50	< 1.0
19755 -- Hg 54, Mouth Ecorse Creek in Detroit River (RM - 16.4)	18,900	540	900	230	< 1.0
19756 -- Hg 3 - RM 13.1 - Detroit River	20,000	170	160	170	4.4
19757 -- Hg 57 - Detroit River - North of Nicholson Dock (RM - 18.1)	15,000	99	110	80	6.0
19758 -- Hg 129 - Mouth of Rouge River (RM - 19.4-0.1)	16,700	26	54	30	< 1.0
19759 -- R-104, Head of Detroit River,(RM 30.8)	18,600	9	22	10	< 1.0
4/16/70 -- B-4 - Mouth of Black River	8,100	68	82	40	< 1.0
4/14/70 -- A-4 - Mouth of Ashtabula River	7,800	910	79	60	1.1

DRY WEIGHT BASIS

SEDIMENTS
(Table 12 Cont'd)

National Field Investigations Center
Office of Enforcement & Standards Compliance, FWQA

SAMPLE DESIGNATION	Mn mg/kg	Fe mg/kg	Cu mg/kg	Zn mg/kg	Cd mg/kg
19747 -- 5/6/70 Detroit River Lt. 29	1,300	14,100	36	150	< 30
19748 -- 5/6/70 Detroit River (Lake Erie) Detroit River Light (RM - 0.0)	510	36,500	140	600	< 30
19749 -- T.83 Monroe, Raisin River Turning Basin (RM - 1.6)	540	23,300	58	360	< 30
19750 -- Monroe Navigation Channel B-7 Lake Erie 8.1 S - 8.7 W	570	32,000	160	500	< 30
19751 -- 19.6S 14.5 W-Hg 33-Lake Erie, Toledo, (Lt. 38-BC 37) Mouth Maumee River	410	17,800	27	96	< 30
19752 -- Hg 36, Second R R Bridge, Maumee River (RM - 2.1)	590	35,600	79	330	< 30
19755 -- Hg 54, Mouth Ecorse Creek in Detroit River (RM - 16.4)	780	56,900	290	1,300	< 30
19756 -- Hg 3 - RM 13.1 - Detroit River	700	28,800	130	440	< 30
19757 -- Hg 57 - Detroit River - North of Nicholson Dock (RM - 18.1)	440	36,800	79	430	< 30
19758 -- Hg 129 - Mouth of Rouge River (RM - 19.4-0.1)	440	13,800	41	110	< 30
19759 -- R-104, Head of Detroit River,(RM 30.8)	530	6,900	9	35	< 30
4/16/70 -- B-4 - Mouth of Black River	490	30,600	78	340	< 30
4/14/70 -- A-4 - Mouth of Ashtabula River	700	33,300	44	300	< 30

DRY WEIGHT BASIS

SEDIMENTS

(Table 12 Con'd)

National Field Investigations Center
Office of Enforcement & Standards Compliance, FWQA

SAMPLE DESIGNATION	Mg mg/kg	Cr mg/kg	Pb mg/kg	Ni mg/kg	Hg mg/kg
4/15/70 -- C-6 - Cleveland Harbor - 400' NNW of Cuyahoga R. mouth	7,400	200	340	60	< 1.0
4/15/70 -- G-5 - Fairport Harbor, 700' North of Grand River mouth	7,300	210	51	30	2.0
4/30/70 -- J41-1 - Presque Isle Bay, 1 mile 257° true from foot of State street public dock, Erie, Pa.	8,600	110	200	50	1.1
5/6/70 -- Mouth of Buffalo River (RM - 0.0)	11,200	260	420	40	2.6
4/16/70 -- S-7 - Sandusky Bay - 1.2 miles 10° true from Sandusky Court House	11,800	33	62	20	< 1.0
5/5/70 -- Dunkirk - 3 mile north of Dunkirk Harbor entrance light	10,300	67	100	50	< 1.0
5/4/70 -- Lake Erie Station C-15-1 of Vermillion 5 miles north	10,800	67	97	40	< 1.0
5/4/70 -- Lake Erie, 1 mile north of Vermillion	17,300	20	73	30	< 1.0
5/11/70 -- C 23-9 - 2 miles at 53° true from Cleveland east entrance light	76,390	36	64	20	< 1.0
5/11/70 -- C 22-73 - 3.25 miles north of Cleveland Harbor light	40,100	31	85	20	2.4
WATER	mg/l	mg/l	mg/l	mg/l	mg/l
Detrex # 1 -- Sump Effluent 5/11/70	9.9	< 0.08	< 0.05	< 0.05	0.017
Detrex # 4 - 5/11/70 Lake Erie, Linde outfall to Erie	9.1	< 0.08	< 0.05	< 0.05	0.004

DRY WEIGHT BASIS

SEDIMENTS

(Table 12 Concluded)

National Field Investigations Center
Office of Enforcement & Standards Compliance, FWQA

SAMPLE DESIGNATION	Mn mg/kg	Fe mg/kg	Cu mg/kg	Zn mg/kg	Cd mg/kg
4/15/70 -- C-6 - Cleveland Harbor - 400' NNW of Cuyahoga R. mouth	730	46,300	150	1,200	< 30
4/15/70 -- G-5 - Fairport Harbor, 700' North of Grand River mouth	420	28,800	34	240	< 30
4/30/70 -- J41-1 - Presque Isle Bay, 1 mile 257° true from foot of State street public dock, Erie, Pa.	530	41,400	140	550	< 30
5/6/70 -- Mouth of Buffalo River (RM - 0.0)	730	48,200	210	1,200	< 30
4/16/70 -- S-7 - Sandusky Bay - 1.2 miles 10° true from Sandusky Court House	630	26,900	49	160	< 30
5/5/70 -- Dunkirk - 3 mile north of Dunkirk Harbor entrance light	610	33,100	57	390	< 30
5/4/70 -- Lake Erie Station C-15-1 of Vermillion 5 miles north	510	32,600	61	250	< 30
5/4/70 -- Lake Erie, 1 mile north of Vermillion	470	32,500	32	140	< 30
5/11/70 -- C 23-9 - 2 miles at 53° true from Cleveland east entrance light	490	28,900	36	200	< 30
5/11/70 -- C 22-73 - 3.25 miles north of Cleveland Harbor light	520	30,700	39	260	< 30
WATER	mg/l	mg/l	mg/l	mg/l	mg/l
Detrex # 1 -- Sump Effluent 5/11/70	< 0.05	0.2	< 0.06	< 0.2	< 0.2
Detrex # 4 - 5/11/70 Lake Erie, Linde outfall to Erie	< 0.05	0.1	< 0.06	< 0.2	< 0.2

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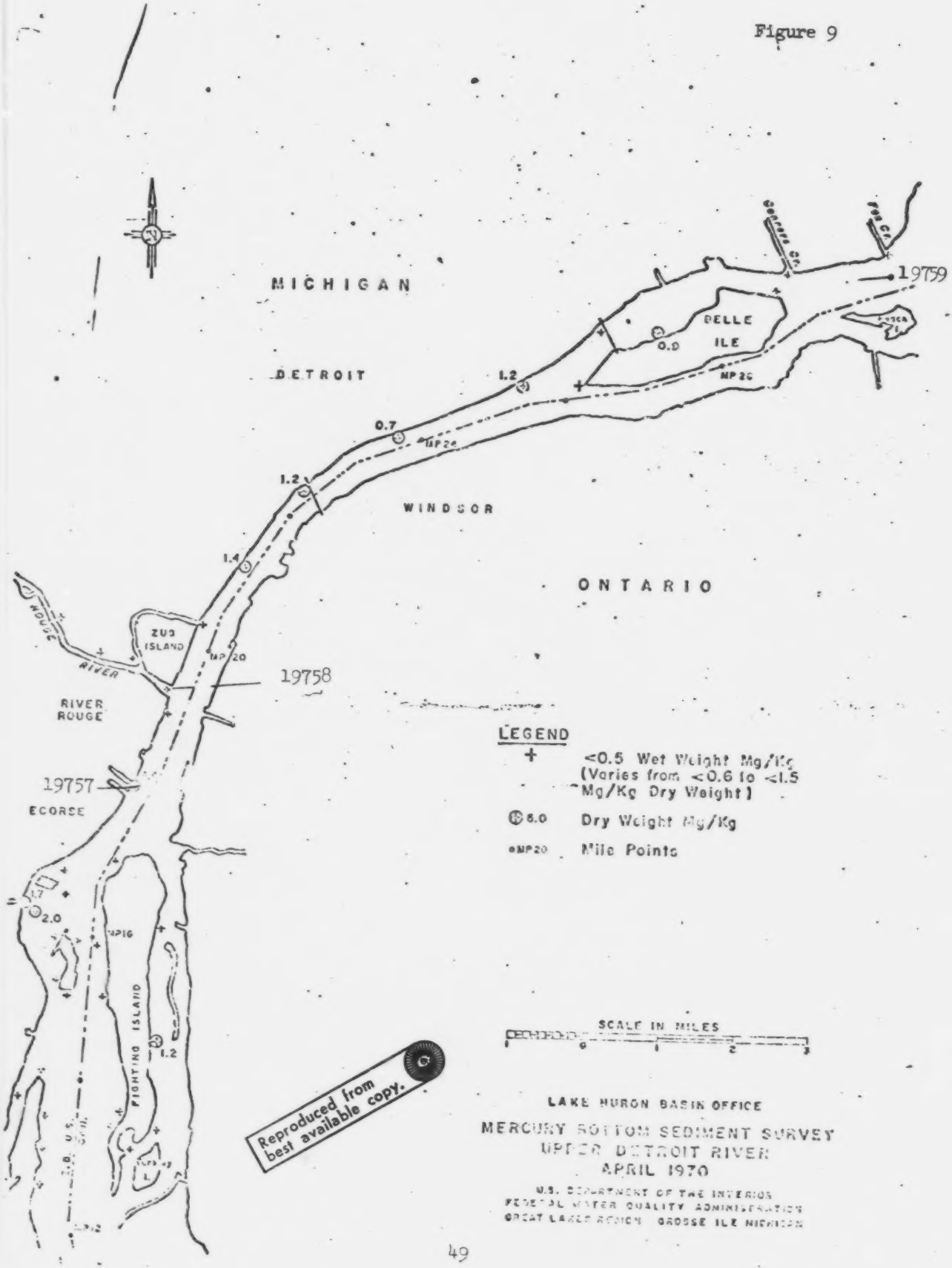
Figure 9



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LAKE HURON BASIN OFFICE

MERCURY BOTTOM SEDIMENT SURVEY
UPPER DETROIT RIVER
APRIL 1970

U.S. DEPARTMENT OF THE INTERIOR
FEDERAL WATER QUALITY ADMINISTRATION
GREAT LAKES REGION - GROSSE ILE MICHIGAN

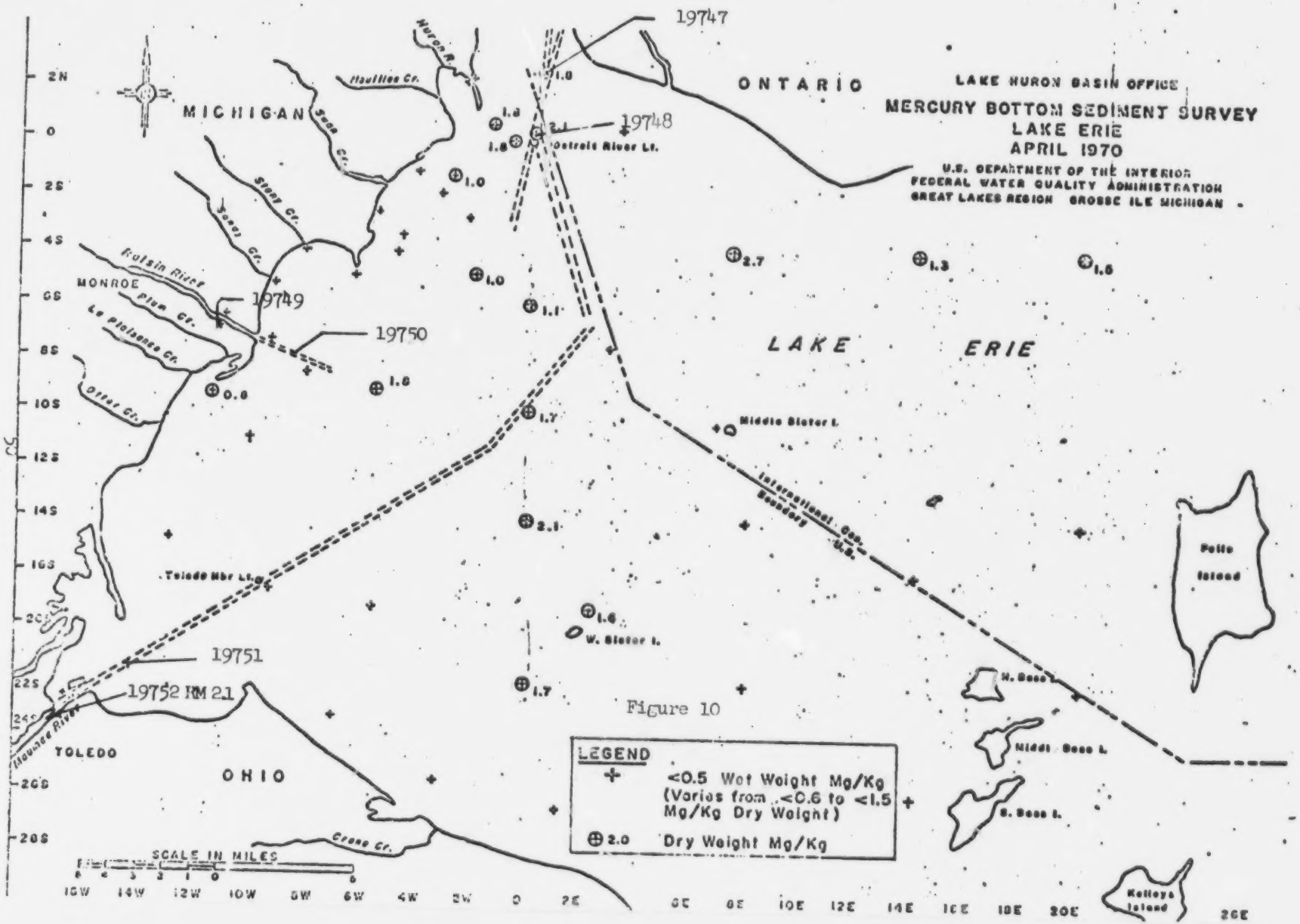

LAKE HURON BASIN OFFICE
MERCURY BOTTOM SEDIMENT SURVEY
LAKE ERIE
APRIL 1970
U.S. DEPARTMENT OF THE INTERIOR
FEDERAL WATER QUALITY ADMINISTRATION
GREAT LAKES REGION GROSSE ILE MICHIGAN
MICHIGAN
ONTARIO
OHIO
LAKE ERIE
TOLEDO
MONROE
Huron R.
Swan Cr.
Stony Cr.
Raisin River
Plum Cr.
La Plaisance Cr.
Otter Cr.
Detroit River Lt.
Toledo Hbr Lt.
Middle Sister I.
W. Sister I.
International Govt. Boundary U.S.
Pelee Island
N. Bass I.
Middl Bass I.
S. Bass I.
Kelleys Island
Grassy Cr.
Maumee River
19747
19748
19749
19750
19751
19752 RM 21
LEGEND
<0.5 Wet Weight Mg/Kg (Varies from <0.6 to <1.5 Mg/Kg Dry Weight)
2.0 Dry Weight Mg/Kg
SCALE IN MILES

Figure 10

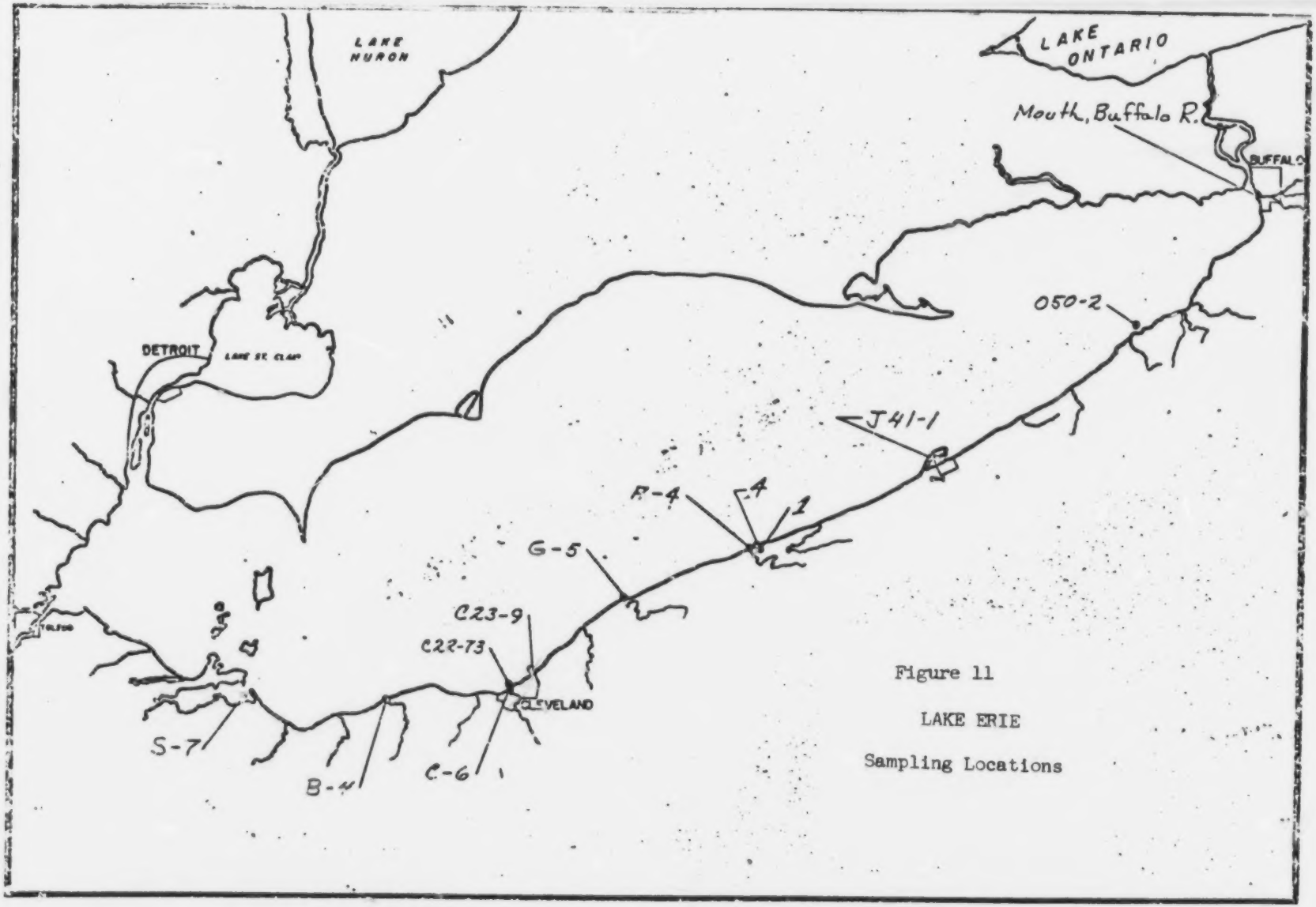


Figure 11

LAKE ERIE

Sampling Locations

APPENDIX I

REPORT ON WYANDOTTE CHEMICALS CORPORATION, WYANDOTTE, MICHIGAN

Investigation of Wyandotte Chemicals Corp.

Following the discovery of mercury in fishes caught in Canadian waters, the State of Michigan reviewed the mercury-using industries in the State and found that the Wyandotte Chemicals Corporation of Wyandotte, Michigan was a major user of mercury. The Michigan Water Resources Commission, after consultations with the Wyandotte Chemicals Corp., gave the following information to the Lake Huron Basin Office of the Federal Water Quality Administration.

The mercury cell operation at Wyandotte consumes an average of 80 pounds per day of mercury, of which approximately 10 to 20 pounds per day is discharged to the river. Wyandotte Chemicals bases their estimate of 10 to 20 pounds per day on composite samples collected and composited for three 8-hour periods each day. The pounds per day figures given for FWQA sampling generally indicate higher values. However, FWQA conducted grab sampling operations at the point of discharge to the river which are generally not directly comparable with composite figures when there is variation in concentration of waste throughout the day. It was also discovered from consultations with Wyandotte Chemicals that concentration varies throughout the cross section of the discharge flume. The Lake Huron Basin Office began sampling the effluent from Wyandotte Chemicals on March 27, 1970. The results are given in the following table:

Effluent Samples by FWQA from Wyandotte Chemicals Corp.
(Outfall Code W23)

Date	Day	Mercury Content (mg/l as Hg) AM	PM	Approx. Loading (lbs/day)
March 27	F	.10		11
30	M		.32	36
31	T	.66		74
April 3	F	.33	.23	31
6	M	.24	.11	18
7	T	.14	.40	30
8	W	.11	.11	12
9	T		.32	36
10	F	.12	< .01 (effluent from mercury cells diverted to temporary treatment pond at 1230)	

April 3 - Wyandotte Chemicals was called into the Michigan Water Resources Commission office and proposed a system of treatment which was tentatively approved by the State agency. Construction began immediately. Effluent pipes at the mercury cell were blocked up and a temporary above-ground piping system has been installed from that point to a large concrete-lined containment area which had formerly been used for storage of limestone. An earth dike was used to form a reaction pond area at the south end of the pond, the remainder of the pond being used as a settling area. Weak cell liquor was introduced to the pipeline to keep the pH above normal. An estimated 600 gallons per minute of mercuric chloride waste from the mercury cell was then discharged through the pipeline to a baffled timber mixing box before discharge to the reaction pond. NaHS and spent sulfuric acid were added at the mixing box before discharge to the reaction pond. After about six hours retention in the reaction pond, the effluent discharges through

another mixing box to the settling pond, at which point cell liquor is added to bring the pH to neutral. In the settling pond, mercuric sulfide is precipitated which removes approximately 80 to 90 percent of mercury. The discharge from this pond was then discharged to a larger sewer which contained other wastes from the plant and then discharged to the Detroit River.

April 10 - The above system was placed in operation. All waste from the mercury cell was diverted into the pond system. There was no detectable discharge to the river, as indicated in the following table:

Date	Day	Mg/l as Hg AM	Mg/l as Hg PM	Approx. lbs/day
April 13	M		<.005	0
14	T	<.005	<.005 (pond filled, treated effluent discharging to sewer at 1930)	0

April 15-16 - Waste discharged to the river through the temporary treatment system contained approximately two pounds of mercury/day.

Date	Day	Mg/l as Hg AM	Mg/l as Hg PM	Approx. lbs/day
April 15	W	.006	.026	1.8
16	T	.027	<.005 (plant shut down by State of Michigan-temporary injunction at 1620)	1.4
17	F		.023	2.6
18	S	<.005		0
19	S	<.005		0
20	M	<.005	<.005	0
21	T	.008	.005	.7
22	W	<.005		0
23	T	<.005	<.005	0
24	F	.015	.018	1.8

(Losses from W-23 on 4/24 and other minor losses since are verified by Wyandotte Chemicals thru MWRC. No explanation can be found. Wyandotte Chemicals is conducting an intensive cleanup of all piping, valving building areas, etc., around the mercury cell operation to prevent further losses.)

Date	Day	Mg/l as Hg AM	PM	Approx. lbs/day
We can probably expect small losses from accumulations of 30 years of use. Storm runoff from roof and grounds may also contribute.)				
April 25	S	.010	.006	0.9
26	S	<.005	.005	Tr
(Operation of mercury cell process was resumed. State of Michigan approved a plan of operation in which mercury waste is treated in settling ponds, then discharged to brine caverns on Grosse Ile. This is a closed system; brine is pumped from the cavern to Wyandotte Chemicals for use in their processes.)				
April 27	M	.007	<.005	Tr
28	T	.005	<.005	Tr
29	W	<.005	<.005	0
30	T	<.005	<.005	0
May 1	F	<.002	<.002	0
4	M	<.002		0
5	T	<.002		0
6	W	.003		.3
7	T	<.002		0
8	F	.003		.3
11	M	<.002		0
12	T	<.002		0
13	W	<.002		0
14	T	<.002		0
15	F	<.002		0
19-22		<.002		0

Tr = Trace amounts

April 16 - Inspection of emergency facilities at Wyandotte Chemicals Plant. L. B. O'Leary, Director of the Lake Huron Basin Office, Federal Water Quality Administration, and W. E. Denniston, District Engineer, Michigan Water Resources Commission, toured the mercury cell and waste treatment operations of Wyandotte Chemicals Corporation accompanied by Mr. J. Hunter, waste control chemist of Wyandotte Chemicals.

The waste treatment operation for the effluent containing mercury is shown on the accompanying sketches.

All waste from the mercury cell operation, including floor drains,

is intercepted before it reaches the river and pumped through temporary above-ground piping systems to the waste pond.

The waste pond is a concrete-lined depression formerly used for limestone storage. Earth dikes divide the pond into two areas; the smaller portion in the south end of the pond is used as a reaction area, and the remainder is used as a settling pond.

The pond took longer than anticipated to fill, indicating leakage. Seams in the concrete were then filled with asphalt compound and an area along the west wall was covered with a clay blanket. These measures apparently stopped the leakage problem. The company representative informed us that under drains from the pond connect to the discharge flume at W23 and the leaks were in the settling pond area so that even if leakage occurred, it would be treated effluent and would be measured at the same point as the effluent from the pond.

Composite samples collected and analyzed by Wyandotte Chemicals on three shifts at a point approximately 20 feet upstream in the waste flume from the point sampled by FWQA at the point of discharge to the river are as follows. Comparison with FWQA sampling for the same day is shown.

		Mg/l as Hg			
					Approx. lbs/day
April 15	Wyandotte Chemicals Composite	.027	.014	.012	1.8
		AM	PM		
	FWQA Grab Samples	.006	.026		1.8

FIGURE 1

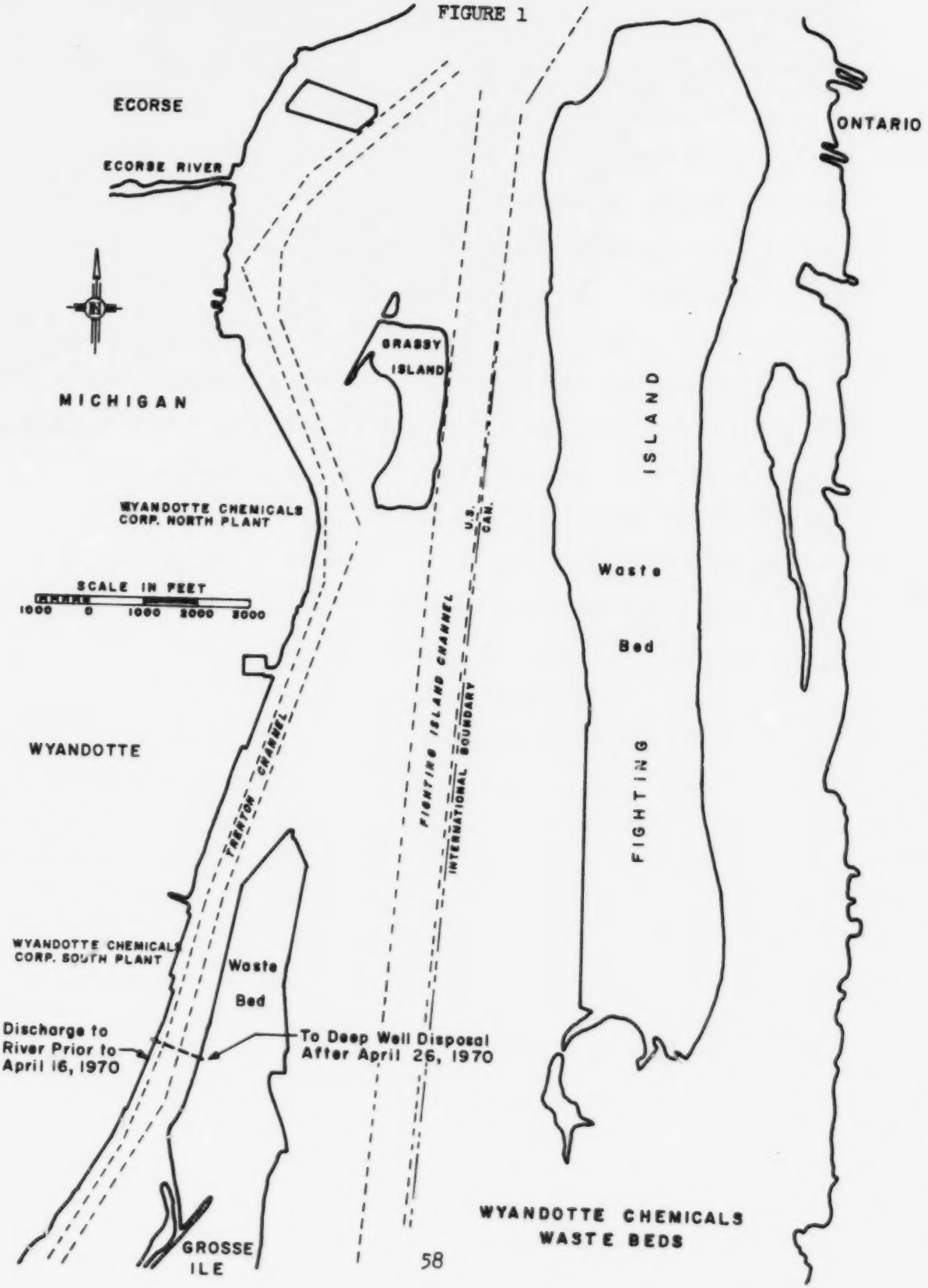

ECORSE
ECORSE RIVER
MICHIGAN
GRASSY ISLAND
ONTARIO
ISLAND
WYANDOTTE CHEMICALS CORP. NORTH PLANT
SCALE IN FEET
1000 0 1000 2000 3000
Waste
Bed
FIGHTING
FIGHTING ISLAND CHANNEL
INTERNATIONAL BOUNDARY
U.S.
CAN.
TRENTON CHANNEL
WYANDOTTE
WYANDOTTE CHEMICALS CORP. SOUTH PLANT
Waste
Bed
Discharge to River Prior to April 16, 1970
To Deep Well Disposal After April 26, 1970
GROSSE ILE
WYANDOTTE CHEMICALS WASTE BEDS

FIGURE 1A

LAKE HURON BASIN OFFICE

SKETCH OF
WYANDOTTE CHEMICALS
TEMPORARY MERCURY TREATMENT
APRIL 16, 1970
No Scale

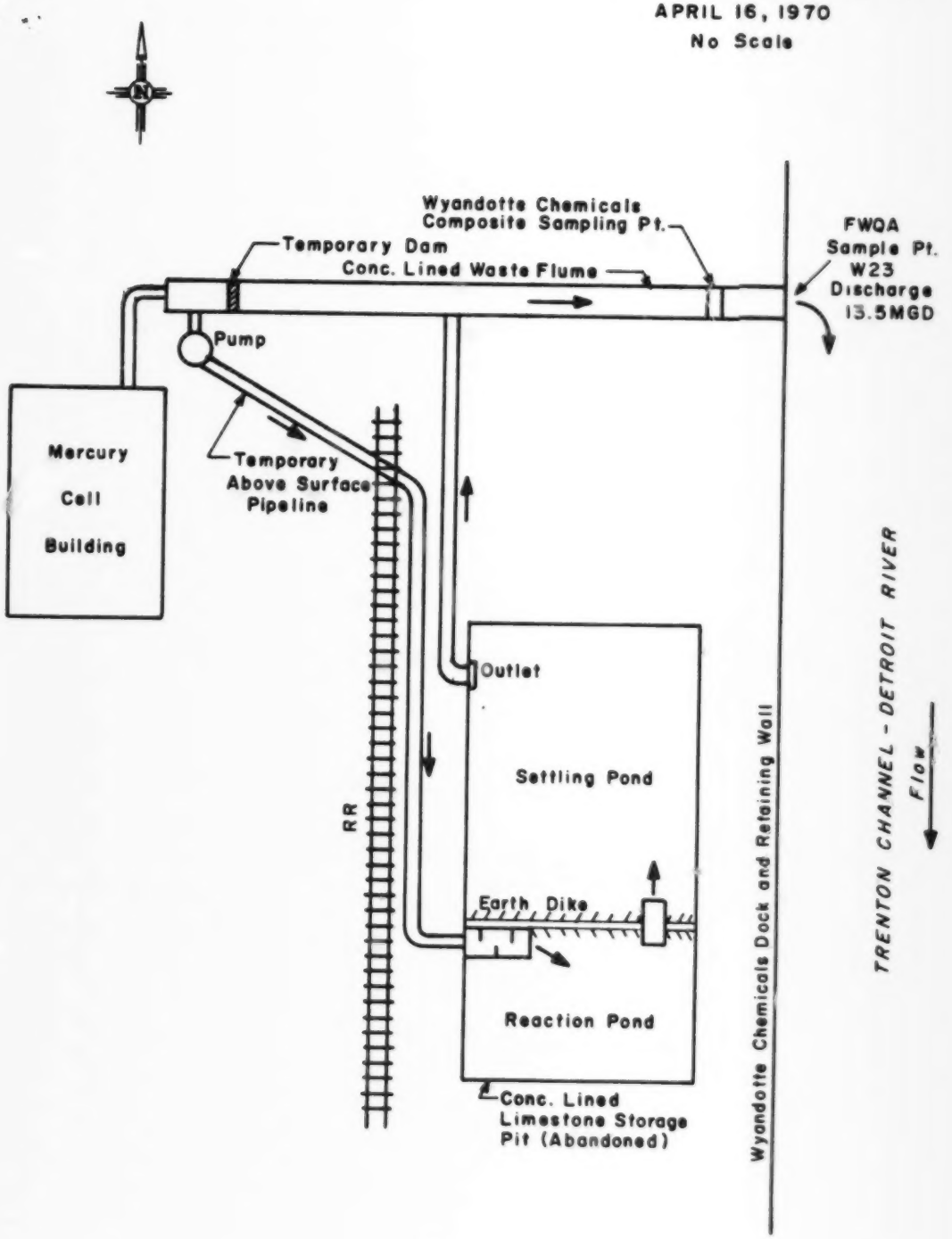
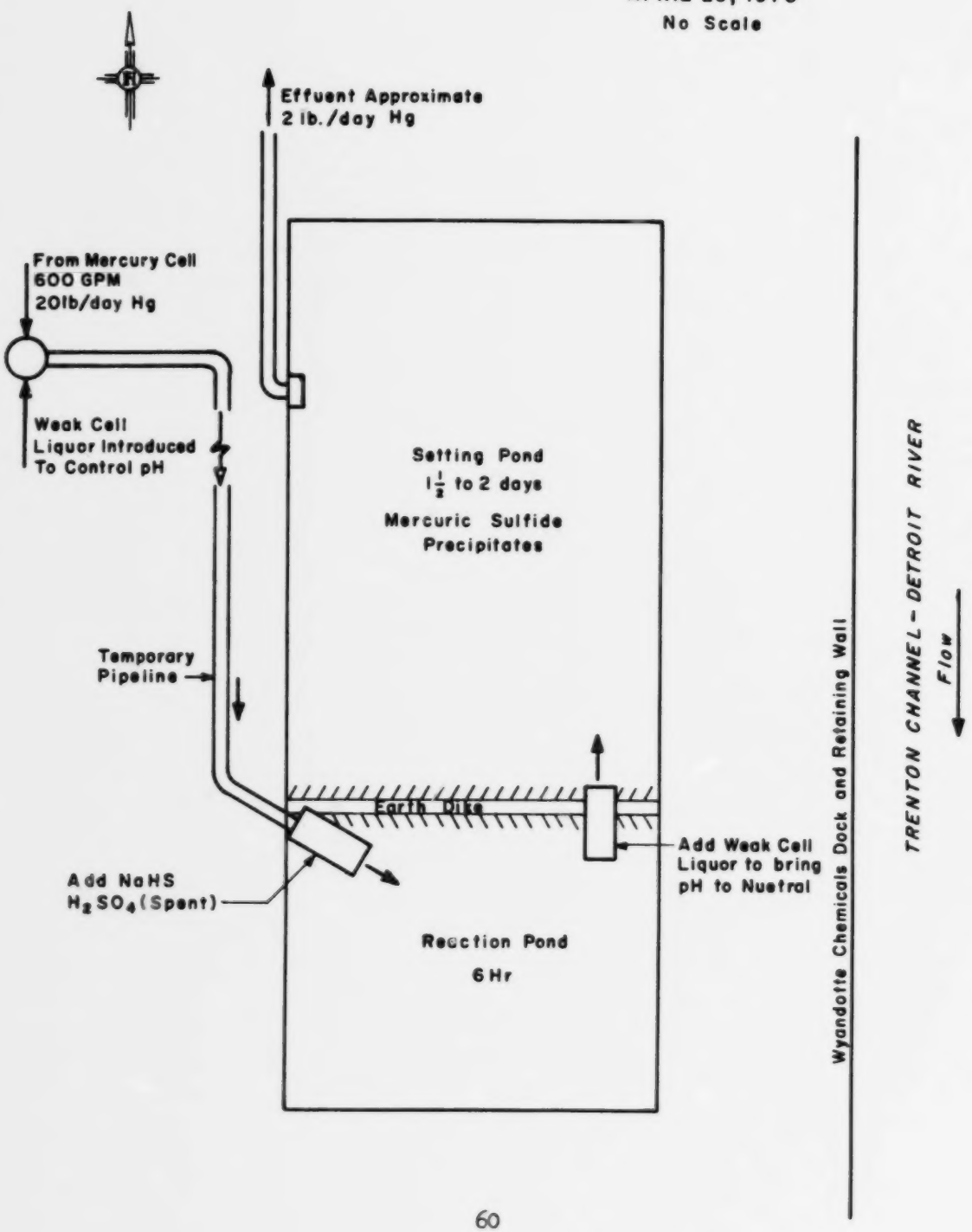


FIGURE 2

LAKE HURON BASIN OFFICE

SKETCH OF
WYANDOTTE CHEMICALS
TEMPORARY MERCURY TREATMENT
APRIL 20, 1970
No Scale



APPENDIX II

REPORT ON DETREX CHEMICAL CORPORATION, ASHTABULA, OHIO

PRELIMINARY REPORT ON MERCURY INVESTIGATIONS AT
DETREX CHEMICAL CORPORATION, ASHTABULA, OHIO

April 29, 1970

DETREX PROCESS OPERATIONS

Detrex employs the mercury cell in the production of caustic soda (NaOH) and chlorine. In this process brine is decomposed in an electrolysis cell which utilizes mercury as the cathode and graphite as the anode. Chlorine collects at the anode and is led with slight vacuum to the outlet end (upper portion) of the cell. Sodium immediately forms an amalgam with the mercury, the mercury being placed in a thin layer at the bottom of the cell.

The basic reactions involved are:

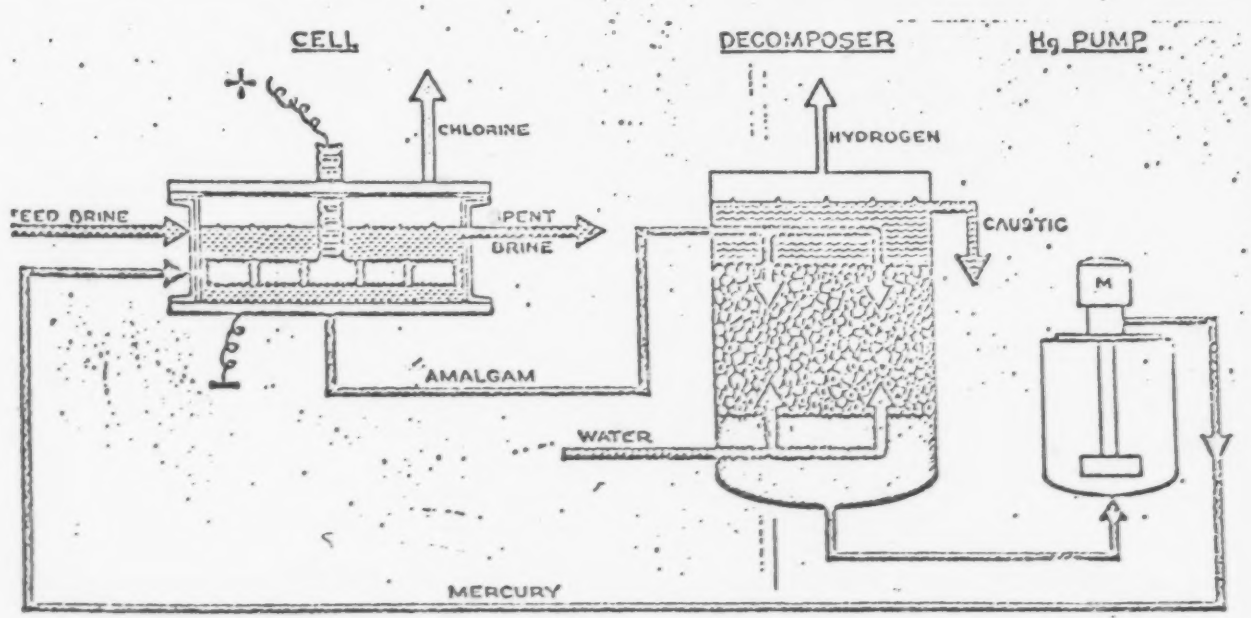
$$2\ NaCl \rightarrow 2\ Na^+ + 2\ Cl^-$$
$$2\ Cl^- \rightarrow Cl_2 + 2e \quad \text{(at graphite anode)}$$

$$2\ Na^+ + 2e \rightarrow 2\ Na \quad \text{(at mercury cathode)}$$

Through an opening at the bottom of the electrolysis cell, the sodium amalgam is directed to a scrubber-like tower (decomposer) where decomposition of the sodium amalgam takes place. The amalgam is introduced from above, through a series of graphite packings. Water is introduced from below and rises counter-current to the amalgam. The amalgam decomposition is effected by the formation of a large number of short circuited cells in which the amalgam and graphite are electrodes and the generated caustic solution is the electrolyte. The reaction which takes place is:

$$2\ Na\ (amalgam) + 2\ H_2O \rightarrow 2\ NaOH + H_2\uparrow$$

The mercury which is released from the amalgam collects at the bottom of the decomposer where it is withdrawn by a mercury pump and returned to the electrolysis cell. Hydrogen gas, along with traces of mercury vapor, is drawn off through a vent at the top of the decomposer and the caustic solution flows through an exit on the side near the top, as shown in the diagram. Some trace mercury contaminated hydrogen is sold to Linde Welding. The remainder is vented to the atmosphere through steam. Steam minimizes the possibility of fire and explosion.



SCHEMATIC DIAGRAM OF A MERCURY CELL

from Blew-Knox Company -
"The Olin Mathieson Mercury Cell Process"
1963 Form No. 2723 3M

MERCURY LOSSES

According to Detrex at the time of the present investigation (1) there had been no change in recent weeks in the amount of mercury lost in the Chlor-Alkali process, (2) the present loss rate is representative of mercury losses since 1963, and (3) mercury analyses of the discharge effluent have, in the past, been made approximately once per month.

Detrex mercury purchases for electrolysis cell make-up, according to the plant manager, amount to 8-10 flasks per month. One flask of mercury is equivalent to 76 lbs. of mercury (mercury is 13.5 times as heavy as water). Detrex claims that all the 760 lbs. of monthly make-up mercury does not find its way to receiving waters - they claim some of it is pilfered because of its high market value (Retail $23 per lb. - Detrex $7 per lb.).

Since March 4, 1970 Detrex has been making frequent analyses for mercury in its waste discharge, sampling at the mouth of a multiple industry used waste water drainage ditch (station No. 4, attached map). Beginning April 17, the Lake Erie Basin Office has sampled daily several sites in the Detrex vicinity including station No. 4, a station (No. 2) in the ditch just below Detrex containing only that company's discharges, and a station (No. 1) at the Detrex sump effluent. The sump effluent is probably the source of most if not all present mercury discharge. Table 1 lists all the mercury analyses to date of samples from the above three stations.

TABLE 1

MERCURY ANALYSES OF DETREX EFFLUENT AND RECEIVING WATERS

Date	Sta. No. 4 Ditch mouth mg/l	lbs/day**	Sta. No. 2 Ditch below Detrex mg/l	lbs/day***	Sta. No. 1 Sump effluent mg/l	lbs/day***
3-4-70	0.02	3.9				
3-13-70	0.02	3.9				
3-18-70	0.34	66.2				
3-25-70	<0.02	<3.9				
4-3-70	0.07	13.5				
4-6-70	0.11	21.4				
4-7-70	0.04	7.8				
4-8-70	0.01*	1.9				
4-9-70	0.29*	56.4				
4-10-70	0.01*	1.9	0.18	3.5		
4-17-70	0.009	<1.7	0.340	9.5	0.072	1.1
4-18-70	<0.005	<1.0	0.040	1.1	0.020	0.3
4-19-70	0.012	2.3	0.135	3.8	0.108	1.7
4-20-70	0.005	1.0	0.058	1.6	0.092	1.4
4-21-70	0.013	2.5	0.058	1.6	0.046	0.7
4-22-70	0.005	1.0	0.035	1.0	0.049	0.8
4-23-70	0.007	1.4	0.045	1.3	0.066	1.0
4-24-70	0.006	1.1	0.030	0.8	0.021	0.3
5-6-70	0.002	0.4			0.044	0.7

Underlined analyses by Detrex; all others by LEBO

* Data obtained from Detrex on 4-17-40; data reported earlier by Detrex did not include 4-9-70 analyses and showed <0.01 mg/l for 4-8-and 4-10-70.

** Loadings based upon 23.3 mgd ditch flow which includes flow from Detrex, Linde Welding, and Linde Air.

*** Loadings based upon 3.34 mgd from Detrex only.

**** Loadings based upon 1.87 mgd from Detrex sump effluent only (56% of Detrex total flow)

TABLE 1 (Cont'd)

MERCURY ANALYSES OF DETREX EFFLUENT AND RECEIVING WATERS

Date	Sta. No. 4 Ditch mouth		Sta. No. 2 Ditch below Detrex		Sta. No. 1 Sump effluent	
	mg/l	lbs/day**	mg/l	lbs/day***	mg/l	lbs/day***
5/11/70	0.006	1.2			0.029	0.5

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Underlined analyses by Detrex; all others by LEBO

* Data obtained from Detrex on 4-17-40; data reported earlier by Detrex did not include 4-9-70 analyses and showed <0.01 mg/l for 4-8-and 4-10-70.

** Loadings based upon 23.3 mgd ditch flow which includes flow from Detrex, Linde Welding, and Linde Div.

*** Loadings based upon 3.34 mgd [illegible] only.

**** Loadings based upon 1.87 mgd from Detrex sump effluent only (56% of Detrex total flow)

Data collected by the Lake Erie Basin Office on April 10 and later (Table 1) indicate that discharges to the lake have, in fact, been significantly reduced. Loadings which had previously ranged up to 66 lbs/day have been reduced to less than 2 lbs. per day. However, simultaneous data from the ditch at station No. 2 and at the sump effluent (station No. 1) indicate that mercury still continues to be discharged by Detrex. The data from station No. 2, which one would expect to show intermediate values between those of the sump effluent and the ditch mouth, were in most cases the highest. The anomaly is tentatively explained as being the result of the sampling technique which most likely included some of the "fluffy" sediment from the very shallow ditch waters. The comparatively low concentrations and loadings in the ditch mouth waters indicate that much of the mercury has been settling out in the ditch between Detrex and the lake. Sediment analyses at station No. 2 (see Table 2) show that the ditch sediments do contain significant amounts of mercury.

All mercury in water discharged from the ditch, according to the Ohio Department of Health, is attributable to Detrex since Linde Air and Linde Welding do not use or store mercury on the premises. Analyses of Linde Air and Linde Welding effluents, as listed in Table 2, support that assumption.

Three plants discharge to the waste drainage ditch. The names of those plants and their average flows, according to the Ohio Department of Health, are as follows:

Detrex	3.34 mgd
Linde Air	15.84 "
Linde Welding	4.14 "
Total	23.32 "

On a yearly average, according to the Detrex plant manager, the plant uses 2,750 gallons of water per minute or 3.96 mgd, somewhat higher than the above listed figure. As a result of in-process changes to April 21, 1970, also according to the plant manager, approximately 44% of the total Detrex flow or 1,200 gpm (1.73 mgd) has been removed from the sump, since it is mercury free.

Beginning April 8, 1970, Detrex made a change in discharge practices which it claims is responsible for the low effluent mercury concentrations beginning April 8, 1970. Prior to this time, all Detrex waste waters, including cooling waters, were discharged to the sump preceding the ditch that flows to the lake. The discharge change, claimed by Detrex to have been motivated by economic considerations, involved the removal of some cooling waters from the sump by bypassing the cooling waters through over-sump pipes directly to the ditch. With removal of the cooling waters from the sump, the detention time of the remaining waste discharged to the sump is increased. As a result larger quantities of suspended mercury compounds become settleable and should be removed in the sump.

STATE AND FEDERAL ACTIONS

On April 10, 1970, after the Ohio Health Department had determined that Detrex Chemical Corp. was a probable source of mercury discharge, a visit was made to the plant by Robert Swain, Ohio Department of Health, and Chris Potos, FWQA Lake Erie Basin Office. They met with Robert Baker, (plant manager), Robert Jones, John Kehm, and Dennis Ahistrom of Detrex Corporation. The purposes of this meeting were to learn

specifics of the Detrex operation and to determine mercury loss rates, recent changes in the loss rates, and amounts discharged to waters of the state. At that time Detrex had already begun changing its operations to divert "clean" water from its mercury-containing waste flow.

On April 13, 1970 the Ohio Water Pollution Control Board issued a "cease and desist" order to the Detrex Corporation. It contained no time limit for compliance. A copy of this order and the reply to it are attached. The Detrex reply, dated April 17, claimed no mercury discharge to the waters of the state.

On April 17, 1970 Chris Potos and A. R. Winklhofer, FWQA Lake Erie Basin Office, met at Detrex with Messrs. Robert Emmet, Detrex Vice President and Robert Baker, plant manager, and with Mr. Robert Swain of the Ohio Department of Health to determine steps taken by Detrex to eliminate mercury discharges to waters of the State as demanded in the State's Cease and Desist order of April 13, 1970.

According to the plant manager steps taken by Detrex as of April 17 were as follows:

1. Floor washing stopped and all mercury picked up with vacuum cleaner since April 16, 1970.

2. Cell cleaning discontinued April 16, 1970 and no cells have been opened or cleaned since that time.

   Reference to 1. and 2. above--

   Detrex is installing a collecting tank and pump to collect floor water, cell spent brine, cell wash water, and return it to the brine system, at which time cell cleaning will be resumed.

3. Mercury treating has been stopped completely and indefinitely.

4. The following indirect cooling water streams are bypassing the sump:

   (1) Hydrogen gas cooler - approximately 65 gpm
   (2) Nash pump seal water cooler - approximately 100 gpm
   (3) Brine heat exchanger - 600 gpm

5. Detrex is filtering 50% caustic soda for the scrubber system (hypochlorite)

Detrex is actively engaged in engineering the following changes to:

1. Reroute the brine dechlorination condenser water to bypass the sump - approximately 500 gpm.

2. Provide a sump or catch basin for hydrogen seal pot water, nash pump seal water, etc., which can then be returned to the decomposer feed water.

3. Provide tank, pump piping, etc. to use filtered caustic for neutralizing waste sulfuric acid and chlorine water.

4. Construct a weir in the effluent ditch to measure quantity of flow; can be used also as a sample point.

5. Install caustic filter backwash tank.

Detrex was urgently advised by Mr. Potos on April 17:

1. to cease and desist mercury discharges to Lake Erie immediately

2. that the ditch and the multiple industry-used-settling pond were not to serve as treatment devices for mercury removal. Detrex discharges were to be made free of mercury prior to leaving Detrex property

3. to hire a consulting engineer to build a waste treatment system to permanently free Detrex discharge waters of mercury

4. to keep FWQA and ODH intimately informed through progress reports

On April 21, 1970, Mr. Potos again visited Detrex along with NFIC (FWQA) representatives, Messrs. John Hyland and Laurence Muir, and the Ohio Health Department's Earl Richards, James Shay, and Robert Swain, to further discuss the mercury problem and additional actions to hasten its abatement.

On a yearly average, according to the plant manager, Detrex uses 2,750 gallons of water per minute, with maximum water use occurring in summer. Based on in-process changes to April 21, 1970, approximately 44 percent of Detrex waste water (1,200 gal/min) has been determined by Detrex to be mercury free, and as a result removed from the sump. It is a Detrex objective as of April 21 to recycle waste streams that contain mercury back to the process in an enclosed system if at all possible. Optimum process operations with least possible mercury discharge are expected by Detrex in two to three weeks. If the mercury-laden streams are impossible to recycle, according to Detrex, the sump effluent will be treated as soon as a practical and economically feasible means becomes available. According to Detrex, the best brains in the chlor-alkali industry are working on the problem in a crash-program effort. If this effort does not meet with success, Detrex has agreed to our demand to hire consulting chemists and engineers to solve the problem. Presently this route is not favored by chlor-alkali people since they feel they know more about mercury (production, use, treatment) than any practicing consulting chemist or engineer. The State of Ohio is in complete agreement with Detrex thinking in this respect. Mr. Potos mentioned to them that ion exchange and reverse osmosis are now on a practical state of the art basis.

In an attempt to minimize the effect of expected seasonal increases in precipitation and consequent runoff on ditch sediment resuspension and scouring, Potos suggested that Detrex dredge the ditch from the sump to the settling pond. Detrex exceeded this request by volunteering to excavate a new ditch and complete fill in the old (see map).

During the weekend (April 18 and 19) the settling pond was being given its spring dredging by Linde Welding and the Union Carbide Corp. which owns the entire area and leases segments to various industries. The pond dredging does not seem to have affected mercury concentrations at the ditch mouth approximately one mile distant, at least not through April 20, 1970. Dredgings from the pond are purportedly trucked to State-approved land fill areas according to the Ohio Department of Health.

The Lake Erie Basin Office has sampled stations 1, 2, 3, 4, 5, 7, 8, 9, and 11 daily from April 17 through April 24. Station 11 is influent to the plant. Sampling will continue less frequently after April 24, 1970.

Table 2 lists other miscellaneous mercury sampling analyses in the vicinity of Detrex. At sampling station No. 9, east branch of the ditch, mercury presence is likely the result of back up water from Detrex as there are no known discharges of any kind to this branch.

The samples, both sediment and water, taken by the Lake Erie Basin Office are analyzed colorimetrically by that office using Dithizone with chloroform extraction.

Along with the attached map is a table of Lake Erie Basin Office analyses to date in the Detrex area. (Table 2).

TABLE 2

DETREX AREA MISCELLANEOUS MERCURY ANALYSES

WATER (mg/l) AND SEDIMENT (mg/kg dry)

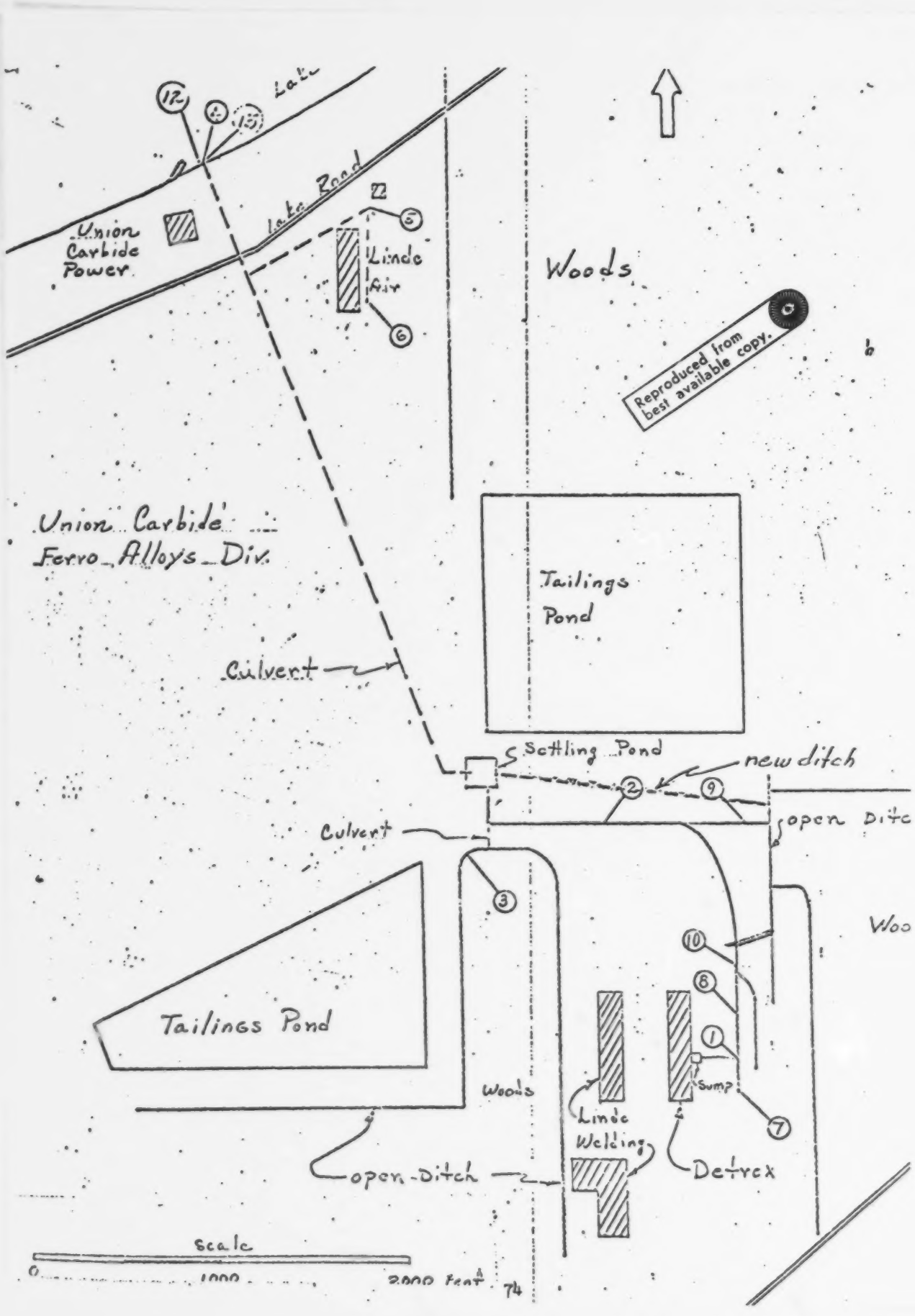
Water Sample

Sta. No.	Station	4/10	4/17	4/18	4/19*	4/20*	4/21	4/22	4/23	4/24
3.	Linde Welding	-	<0.002	<0.002	<0.002	<0.002	<0.002	0.002	0.10	<0.002
5.	Linde Air	-	<0.002	<0.002	0.004	<0.002	<0.002	<0.002	<0.002	<0.002
7.	Caustic Evaporator-Detrex	-	-	0.026	<0.002	0.020	<0.002	<0.002	0.002	0.038
8.	Heat exch-Condenser-Detrex	-	-	<0.002	<0.002	<0.002	<0.002	0.004	0.002	<0.002
9.	East branch ditch	-	-	<0.002	<0.002	0.020	0.058	<0.002	0.010	<0.002
11.	Detrex Influent	-	-	<0.002	<0.002	0.015	<0.002	<0.002	<0.002	<0.002

Sediment Sample

2.	Ditch	-	49	169	-	
3.	Linde Welding	-	< 1	-	-	
9.	East branch ditch	-		13	-	
12.	20 feet North of ditch mouth					< 1
13.	80 feet North of ditch mouth					< 1

*4/19 precipitation 0.48 inches at Cleveland Weather Bureau
*4/20 precipitation 0.24 inches at Cleveland Weather Bureau


Lake
12
4
15
Lake Road
Union Carbide Power
5
Linde Air
6
Woods
Reproduced from best available copy.
Union Carbide
Ferro Alloys Div.
Tailings Pond
Culvert
Settling Pond
new ditch
2
9
open Ditc
Culvert
3
Woo
10
8
1
Tailings Pond
Woods
Sump
7
Linde Welding
Detrex
open Ditch
Scale
0
1000
2000 Feet

JAMES A. RHODES, Governor

EMMETT W. ARNOLD, M.D.
Director of Health

450 East Town Street
P.O. Box 118
Columbus, Ohio 43216

State of Ohio

Department of Health

PUBLIC HEALTH COUNCIL
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J. Bruce Wenger, D.V.M.

April 13, 1970

Detrex Chemicals Industries, Inc.
Chlorine-Alkali Plant
P.O. Box 670
Ashtabula, Ohio 44004

Attention: R. L. Baker, Plant Mgr.

Gentlemen:

You are hereby ordered to cease and desist the discharge of liquid industrial waste containing any mecurial compounds to waters of the state.

Any concentrations of mercury in the raw water used in your plant will be taken into consideration in the compliance with the order.

Please advise this office as to your compliance with the above order.

Yours very truly,

E. W. Arnold, M.D.
Director of Health

Reproduced from best available copy.

CERTIFIED MAIL

RECEIVED
APR 15 1970
DETREX CHEMICAL INDUSTRIES INC.
CHLORINE ALKALI PLANT

DETREX CHEMICAL INDUSTRIES, INC.
Chlorine - Alkali Plant
P. O. BOX 670
ASHTABULA, OHIO

April 17, 1970

State of Ohio
Department of Health
450 East Town Street
P.O. Box 118
Columbus, Ohio 43216

Attention: Dr. E. W. Arnold, Director of Health

Dear Sir:

We received, April 15, 1970, your order "to cease and desist the discharge of liquid industrial waste containing any mercurial compounds to waters of the state."

We had previously taken effluent water samples at our discharge into Lake Erie on April 9th and April 10, 1970. Further samples were taken on April 14th and again on April 16th. In addition, lake bottom samples east, north and west of the discharge were taken on April 15th.

Using analysis methods approved by the State of Ohio, we have obtained negative mercury results on each of the above samples.

In accordance with the above analytical results, we state that the Detrex Chemical Industries, Inc. Chlorine-Alkali Plant at Ashtabula, Ohio is not discharging mercurial compounds to waters of the state.

Very truly yours,

DETREX CHEMICAL INDUSTRIES, INC.

Reproduced from best available copy.

Robert L. Baker
Plant Manager

RLB/nkv

APPENDIX III

Inventory of Industries Using Mercury in the Lake Erie

TABLE
INVENTORY OF INDUSTRIES USING MERCURY

MICHIGAN

Name of Industry Location	Mercury Consumption (Purchased)	Discharge to	Type of Plant	Remarks
W. R. Grace & Co. Veratex Division 18610 Fitzpatrick Detroit, Mich. 48228		Detroit STP	Distributor	Repackages mercury and sells to dentists.
G. A. Ingram Co. 4444 Woodward Ave. Detroit, Mich. 48201	80#/year	Detroit STP	Manufacturers of instruments for medical profession.	Sell glass vials and one-ounce capsules to doctors.
Madison Dental Supply Co. 15888 Wyoming Detroit, Mich. 48238	100#/year	Detroit STP	Distributors of dental supplies.	Repackage mercury and sell to dentists.
H. O. Trerice 1749 Lafayette Blvd. Detroit, Mich. 48216	1000#/year	Detroit STP	Pressure gages and equipment	
Wyandotte Chemical Wyandotte, Mich.	80 lbs/day 30,000 lbs/yr	Detroit River	Chlor-alkali plant mercury cell	See report Appendix I
Penwalt Corp. Wyandotte, Michigan		Trenton Channel Detroit River	Diaphram method Chlor-alkali plant	Do not use mercury in its operation.

1. Paper mills in Michigan were checked for the use of mercury. Two mills use mercury in surfacing compounds and lose about two pounds per year.

2. Spot checks of other waste discharges from Chrysler Corp., Monsanto, Penwalt Chemicals, Wyandotte Chemicals (other than outfall W23 at RM 13.3), and Consolidated Paper revealed no detectable mercury.

TABLE
INVENTORY OF INDUSTRIES USING MERCURY

MICHIGAN

Name of Industry Location	Mercury Consumption (Purchased)	Discharge to	Type of Plant	Remarks
C & M Pharmical, Inc. 1519 E. 8th & Mile Road Hazel Park, Mich. 48203				Management reports no mercury purchased for last 9 years.
Detroit Edison Co. 2000 Second Ave. Detroit, Mich.		Detroit River	Electrical Power Production	Mercury used for switches and gage.
Harry W. Dietert Co. 9330 Roselawn Ave. Detroit, Mich. 48204	50#/year	Detroit STP	Testing equipment and gages.	

TABLE
INVENTORY OF INDUSTRIES USING MERCURY

NEW YORK

Name of Industry Location	Mercury Consumption (Purchased)	Discharge to	Type of Plant	Remarks
Allied Chemical Co. Buffalo Dye Division Buffalo, New York	1560 lb/yr	Buffalo River	Dye plant - disulfonation of anthraquinone to produce disulfo intermediates 1:5 and 1:8.	Operate two processes on a batch basis. Would not reveal to FWQA when the process will be used. Are supposed to notify the New York State Health Department. A sample from the plant discharge on May 8, 1970, at an estimated flow of 4 mgd, had an average concentration of mercury of 0.12 mg/l. This is a discharge of 4 pounds of mercury per day.

TABLE
INVENTORY OF INDUSTRIES USING MERCURY

OHIO

Name of Industry Location	Mercury Consumption (Purchased)	Discharge to	Type of Plant	Remarks
Meriam Instrument Co. Div. of Scott & Fetzer Co. 10920 Madison Ave. Cleveland, Ohio			Instrument manufacture	No water contact with mercury.
The Schuemann-Jones Co. 3030 West 117th St. Cleveland, Ohio			Medical supplies	No water contact with mercury.
Standard Oil Co. of Ohio Midland Building Cleveland, Ohio 44115			Produces switches	No water contact with mercury
Bailey Meter Co. 29801 Euclid Ave. Wickliffe, Ohio 44092		Cleveland Easterly	Produces meters	Water contact in testing of meters. Loss is infinitesimal. 100 gal/day at 0.002 mg/l.
General Electric Co. 4 Plants			Mercury vapor lamps	No water contact with mercury.
1. Cuyahoga Lamp Plant Nela Park, Cleveland, Ohio			Research on fluorescent lamps	End cut from tubes are contaminated with mercury. Ends drop to water bath which is recirculated and has no water discharge.
2. Bucyrus, Ohio			Research on fluorescent lamps	Same process as at Nela Park--closed system.
3. Powder and Wire Plant Euclid, Ohio		Euclid, STP	Tungsten wire and powder	Mercury used in extrusion of wire--no water contact.
4. Chemical Products Plant		Cleveland Easterly STP	Reclaim mercury	Batch process. During discharge concentration was 0.3 mg/l--no volume of flow available. Plant will be resampled to determine concentration and volume.

TABLE
INVENTORY OF INDUSTRIES USING MERCURY

OHIO

Name of Industry Location	Mercury Consumption (Purchased)	Discharge to	Type of Plant	Remarks
Bellows Electric Sign Co. 861 E. Tallmadge Ave. Akron, Ohio 44309			Manufacture signs	No water contact with mercury.
Case Western Reserve Univ. Attn: G. J. Kibler, Mgr. of Purchasing Department 2220 Circle Drive Cleveland, Ohio 44106				
Lincoln Electric Co. 22801 St. Clair Ave. Cleveland, Ohio 44117		Euclid STP	Manufactures welding equipment	No water contact with mercury.
National Aeronautics & Space Administration Lewis Research Center 21000 Brookpark Road Cleveland, Ohio 44135		Rocky River	Research, U.S. Government	Hg. used in ion engine research. Mercury vapor is scrubbed and waste water goes to a lagoon that discharges to Rocky River. Lagoons are usually discharged in the afternoon. Sample of water into lagoons showed <0.002 mg/l mercury. Outfall that receives storm and roof drains showed 0.011 mg/l when no lagoon water was being discharged. Source is unknown.
Owens Illinois Glass Co. All Plants (4) Box 1035-1036 Toledo, Ohio 43601				Company contacted by State. Told State to return at later date. Suspected mercury discharger.

TABLE
INVENTORY OF INDUSTRIES USING MERCURY

OHIO

Name of Industry Location	Mercury Consumption (Purchased)	Discharge to	Type of Plant	Remarks
Reactive Metals, Inc. East 21st St. Ashtabula, Twp.			Manufacture titanium sponge	Possibility of mercury in vapor. Mercury found (42 mg/Kg) in sediment in stream receiving pot wash effluent. Not detectable in water. Source of mercury in sediment should be determined.
Detrex Industries Ashtabula, Ohio	9,120 lbs annually	Lake Erie	Mercury cell Chlor-alkali plant	Management reports Detrex has been purchasing 760 pounds of mercury per month since 1963 to make up for process losses. See Special Report Appendix II
Diamond Shamrock Corp. Electro Chemical Division Painesville, Ohio	Not reported	Grand River to Lake Erie	Diaphram method Chlor-alkali plant	Management reports plant is not using or planning to use mercury in its commercial process. Small amount of mercury used for instrumentation. Diaphram method for production of chlorine and caustic soda does not use mercury. A small amount was used about 2 years ago for 2 days in an experiment to produce chlorine and caustic soda.
Union Carbide Consumer Products Co. Division of Union Carbide P.O. Box 2837 Rocky River, Ohio 44116				No water contact with mercury.

TABLE
INVENTORY OF INDUSTRIES USING MERCURY

PENNSYLVANIA

Name of Industry Location	Mercury Consumption (Purchased)	Discharge to	Type of Plant	Remarks
American Meter Company 920 Payne Avenue P. O. Box 1251 Erie, Penna.				

APPENDIX IV

FISH ANALYSED FOR MERCURY CONTENT

BUREAU OF COMMERCIAL FISHERIES
TECHNOLOGICAL LABORATORY
ANN ARBOR, MICHIGAN

Bureau of Commercial Fisheries
Technological Laboratory
Ann Arbor, Michigan 48107
April 15, 1970

Fish Analyzed for Mercury Content: Report No. 1

Species	Part Analyzed	Code No.	Catch Location	Catch Date	No. fish in Composite	Length ave./range (inches)	Weight ave./range (lbs)	Mercury* Content (ppm, wet wt.)
Yellow perch	whole	-	Lake Erie (Wheatley, Ont.)	12/10/69	(500 lbs)	-	-	0.25
Yellow perch	whole	-	Lake Michigan (Mich City, Ind.)	10/28/69	(550 lbs)	-	-	0.18
Chub	whole	-	Lake Michigan (South Haven, Mich.)	10/28/	(600 lbs)	-	-	0.10
Coho salmon	whole	-	Lake Michigan (Platte River)	11/69	(500 lbs)	-	-	0.30
Coho salmon	whole	-	Lake Eire (Erie, Penna.)	11/69	(600 lbs)	-	-	0.36
Carp	edible 1/	EJG01	Lake Erie (Bono)	4/1/70	10 fish	24.5 / 22.9-26.8	8.92 / 6.46-12.76	0.28
White bass	edible	EPG02	Lake Erie (Bono)	3/30/70	15 fish	10.2 / 9.0-14.3	0.54 / 0.32-1.63	0.80
Yellow perch	edible	EEG02	Lake Eire (Bono)	3/30/70	13 fish	8.46 / 8.0-9.6	0.30 / 0.37-0.47	0.44
Walleye	edible	XNG01	Lake St. Clair (New Baltimore)	3/30/70	5 fish	14.1 / 12.0-17.6	1.11 / 0.60-2.11	1.4
Walleye	edible	XNG02	Lake St. Clair (Rigeon Island)	3/28/70	11 fish	18.9 / 16.4-20.9	2.87 / 1.86-3.69	2.0

1/ Headed and gutted, scaled, tail-off. *Method of Analyses - Atomic Absorption

Bureau of Commercial Fisheries
Technological Laboratory
Ann Arbor, Michigan
April 22, 1970

Fish Analyzed for Mercury Content: Report No. 2

Species	Part Analyzed	Code No.	Catch Location	Catch Date	No. fish in Composite	Length Ave./range (inches)	Weight Ave./range (lbs.)	Mercury * Content (ppm, wet wt.)
Carp	Edible 1/	EJG02	L. Erie (Sandusky, O.)	3/30/70	15	21.5 / 17.0-25.8	6.23 / 2.82-10.49	0.08
Yellow Perch	"	EEG01	"	"	16	0.92 / 0.82-1.08	0.41 / 0.27-0.65	0.32
Coho Salmon	"	EFG01	"	"	14	17.1 / 14.7-18.9	1.85 / 1.04-2.51	0.24
White Bass	"	EPG01	"	"	15	11.7 / 9.1-13.8	0.88 / 0.51-1.46	0.80
Channel Catfish	"	EIG01	"	"	13	15.3 / 13.8-20.0	1.33 / 0.88-3.08	0.32
Sheepshead	"	EOG01	"	"	15	14.9 / 11.8-19.2	1.56 / 0.62-3.19	0.24
Gizzard Shad	"	EQG01	"	"	16	13.4 / 11.8-14.3	1.04 / 0.73-1.84	0.24
Sucker	"	XKG01	L. St. Clair (New Baltimore)	4/1/70	3	14.5 / 11.7-16.8	1.44 / 0.65-2.23	0.88
Northern Pike	"	XLG01	"	"	3	16.9 / 15.6-18.9	0.95 / 0.88-1.19	0.64
Yellow Perch	"	XEG01	"	"	18	9.72 / 8.19-12.09	0.45 / 0.21-0.99	1.10

1/ Headed and gutted, scaled, tail-off. *Method of Analyses - Atomic Absorption

Bureau of Commercial Fisheries
Technological Laboratory
Ann Arbor, Michigan 48107
April 24, 1970

Fish Analyzed for Mercury Content: Report No. 3 (Cont.)

Species	Part Analyzed	Code No.	Catch Location	Catch Date	No. fish in Composite	Length ave./range (inches)	Weight ave./range (lbs)	Mercury* Content (ppm, wet wt.)
N. pike	offal*	XLH01	Lake St. Clair (New Baltimore)	4/1/70	3	16.9 15.6-18.9	0.95 0.88-1.19	0.88
Walleye	offal*	XNH01	Lake St. Clair (New Baltimore)	3/30/70	5	14.1 12.0-17.6	1.11 0.60-2.11	0.80
Walleye	offal*	XNH02	Lake St. Clair (Peach Island)	3/28/70	11	18.9 16.4-20.9	2.87 1.86-3.69	1.40

Edible - Headed and gutted, scaled, tail-off.

Offal - All processing waste from "edible."

* - Denotes the corresponding offal sample for a previously reported edible sample. The third letter in the code No. represents the type of sample; G is "edible," H is "offal."

*Method of Analyses - Atomic Absorption

Bureau of Commercial Fisheries
Technological Laboratory
Ann Arbor, Michigan 48107
May 15, 1970

Fish Analyzed for Mercury Content: Report No. 4

Species	Part Analyzed	Code No.	Catch Location	Catch Date	No. fish in Composite	Length ave./range (inches)	Weight ave./range (lbs)	Mercury Content (ppm, wet wt.)	Method
Yellow Perch	Edible 1/	EEG03	Lake Erie (Monroe)	4/6/70	10	8.35 / 7.7-9.13	0.29 / 0.22-0.41	1.7	AA (WARF)
Yellow Perch	Offal 2/	EEH03	"	"	10	"	"	0.88	"
Coho Salmon	Edible	EFG02	Lake Erie (Bono)	3/30/70	12	17.4 / 16.1-19.1	1.97 / 1.55-2.52	0.96	"
Coho Salmon	Offal	EFH02	"	"	12	"	"	1.0	"
Coho Salmon	Edible	EFG03	Lake Erie (Monroe)	4/10/70	4	18.4 / 17.2-19.5	2.48 / 1.90-2.87	0.96	"
Coho Salmon	Offal	EFH03	"	"	4	"	"	1.2	"
Channel Catfish	Edible	EIG02	Lake Erie (Bono)	3/30/70	10	14.8 / 13.6-16.6	1.00 / 0.72-1.53	1.8	"
Channel Catfish	Edible	EIG03	Lake Erie (Monroe)	4/6/70	10	14.3 / 13.5-15.2	0.98 / 0.78-1.14	1.3	"
Carp	Offal 3/	EJH01	Lake Erie (Bono)	4/1/70	10	24.5 / 22.9-26.8	8.92 / 6.46-12.76	0.44	"

1/ Headed and gutted, scaled, tail-off.

2/ All processing waste from "edible".

3/ Denotes the corresponding offal sample for a previously reported edible sample.
The third letter in the code No. represents the type of sample; G is edible. H is offal.

Bureau of Commercial Fisheries
Technological Laboratory
Ann Arbor, Michigan 48107
May 15, 1970

Fish Analyzed for Mercury Content: Report No. 4 (Cont.)

Species	Part Analyzed	Code No.	Catch Location	Catch Date	No. fish in Composite	Length ave./range (inches)	Weight ave./range (lbs)	Mercury Content (ppm, wet wt.)	Method
Yellow Perch	Offal[3/]	EEH01	Lake Erie (Sandusky)	3/30/70	16	9.2 / 8.2-10.8	0.41 / 0.27-0.66	0.36	AA (WARF)
Walleye	Edible	ENG04	Lake Erie (Monroe)	4/7/70	19	17.9 / 14.9-21.2	2.31 / 1.31-3.86	3.60	"
Steelhead	Edible	ERG01	Lake Erie (Monroe)	4/10/70	2	17.9 / 16.4-19.5	2.03 / 1.34-2.72	< 0.15	"
Walleye	Edible	ENG01	Lake Erie (Sandusky)	4/3/70	10	18.6 / 16.8-21.2	2.77 / 1.94-4.51	2.60[4/] (2.40-2.80)	"
Walleye	Edible (Butterfly fillets)	E-1	Lake Erie (Raison Pt.) (Monroe)	4/30/70	3	Total sample - 2.58 lb.		3.57	AA (EHL)
White Bass	Edible (Single fillets)	E-2	"	4/30/70	10	Total sample - 2.71 lb.		0.53	"

1/ Headed and gutted, scaled, tail-off.

2/ All processing waste from "edible".

3/ Denotes the corresponding offal sample for a previously reported edible sample. The third letter in the code No. represents the type of sample; G is edible, H is offal.

4/ Ave. of six individual determinations on blind, coded samples.

APPENDIX V

STANDARDS FOR MERCURY AND HEAVY METALS

LAKE ST. CLAIR - LAKE ERIE DRAINAGE AREA

FEDERAL-STATE WATER QUALITY STANDARDS AND USPHS DRINKING WATER STANDARDS FOR MERCURY AND HEAVY METALS[1]
LAKE ERIE-LAKE ST. CLAIR DRAINAGE AREA

The National Technical Advisory Committee on Water Quality Criteria states: "Surface waters should be free of substances attributable to discharge or wastes as follows: materials, including radionuclides, in concentrations or combinations which are toxic or which produce undesirable physiological responses in human, fish and other animal life, and plants."

Specific numberical criteria for toxic substances have been included in water quality standards as follows:

State	Metal	Criteria Values in mg/l	Use Classification to Which Applied
Indiana	Cadmium	0.01	Water Supply
	Chromium (hexavalent)	0.05	Water Supply
	Lead	0.05	Water Supply
	Silver	0.05	Water Supply
	All Toxic Materials	0.1 96-hr TLm[2]	Fish & Wildlife
Michigan	Chromium (hexavalent)	0.05	Water Supply
New York	No Specific Criteria		
Ohio	Cadmium	0.01	Water Supply
	Chromium (hexavalent)	0.05	Water Supply
	Lead	0.05	Water Supply
	Silver	0.05	Water Supply
	Iron (certain rivers on Ohio-Pa. border only)	1.5	Water Supply
	All Toxic Materials	0.1 48-hr TLm	Aquatic Life and Recreation
Pennsylvania	Manganese	1.0	All Uses
	Iron (Total)	1.5	All Uses
	Iron (Dissolved)	0.3	All Uses

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1/ Heavy metals considered: cadmium, chromium, copper, iron, lead, manganese, silver, and zinc.

2/ The TLm is the concentration of a toxic material which produces death to one-half of the test organisms in a bioassay test within a specified length of time (e.g. 48 hours or 96 hours).

APPENDIX VI

CHRONOLOGY OF EVENTS

CHRONOLOGY OF EVENTS

March 24, 1970

The Canadian Federal Department of Fish and Forestry banned the sale and export of fish caught commercially within the Canadian boundaries of Lake St. Clair because concentrations of mercury in some of the fish made them unfit for consumption. The decision was made as a result of a research report which showed pickerel caught in the lake contained as much as seven parts per million mercury (ppm). Subsequent laboratory reports indicated a somewhat lower figure of 1.36 ppm which, however, is still almost three times as great as 0.5 ppm level considered acceptable for fish procured for export by federal food and drug authorities in both Canada and the United States. The Ontario Water Resources Commission identified one Dow Chemical of Canada Limited chlor-alkali plant at Sarnia, Ontario as the source of mercury pollution to the St. Clair River.

FWQA Regional Office learned from Mr. Ralph Purdy, Executive Secretary, Michigan Water Resources Commission, that he had written letters to chlor-alkali plants in the state to find out who was using mercury cells. He reported that the Wyandotte Chemical Company on the Detroit River uses mercury cells and that he was conducting discussions with them to learn about the disposition of their mercury bearing wastes.

March 26, 1970

Coordination achieved with Michigan agencies, Ontario Water Resources Commission, Bureau of Commercial Fisheries, and Food and

Drug Administration. FWQA Lake Huron Basin Office initiates a water and sediment sampling program for the St. Clair River, Lake St. Clair, Detroit River, and Western Shore of Lake Erie. Advised that Field staffs of the Bureau of Commercial Fisheries, Great Lakes Fisheries Laboratory, Ann Arbor, and the Department of Natural Resources, would be conducting a fish sampling program and that arrangements were being made for the Wisconsin Alumni Research Foundation (WARF), Madison, Wisconsin to analyze the fish samples. Learned that the Michigan Health Department and the Michigan Water Resources Commission were getting samples from water intakes, treatment plants and industrial outfalls for analyses of mercury at the Lansing laboratory.

March 27, 1970

FWQA Lake Huron Basin Office begins collecting water and sediment samples from the Wyandotte Chemical plant.

April 2, 1970

Regional Director, GLR, chaired an informal meeting at FWQA Headquarters, Washington, D. C., with Bureau of Commercial Fisheries, Bureau of Sports Fisheries and Wildlife, Food and Drug Administration, and Ontario and Canadian Federal representatives. The meeting was called to obtain a better understanding of the mercury problem and to exchange information. It was the consensus of the representatives present that the mercury problem is serious and of international concern. It was also agreed that an inventory of mercury uses to determine waste concentration was needed and that sampling should continue in order that the problem may be completely defined.

April 8, 1970

Governor Milliken of Michigan advises sportsmen not to eat fish caught from Lake St. Clair and the Detroit and St. Clair Rivers.

April 10, 1970

A meeting of Ontario, Michigan, and Ohio representatives was held in Toronto, Ontario to share information and explain how decisions were reached for Ontario to place a ban on fishing in Lake St. Clair, St. Clair River, and Detroit River. Federal people from Canada and the United States were invited as observers. Mr. O'Leary of the Lake Huron Basin Office, represented the FWQA Great Lakes Region at the meeting.

Rperesentatives of all agencies agreed that sampling and testing must continue in order that the problem may be completely defined.

Mr. Kerr, Federal Energy and Resources Minister, described the action that has been taken to halt any further mercury discharge from the presently known source of pollution on the Canadian side of the boundary in this area, and Governor Milliken stated that he had received an assurance today that the presently known source on the Michigan side had today instituted procedures to eliminate future mercury contamination of the water from its facility.

It was agreed that future action will be taken in a coordinated way so that all involved agencies may take similar action.

The representatives of the States of Ohio and Michigan agree with those from Ontario that a ban on fishing in Lake Erie is not

indicated at this time. Their respective agencies agreed to exchange information from their sampling and testing programs.

Governor Milliken announced the following actions and agreements:

1. Michigan will institute proceedings to close Lake St. Clair and the St. Clair River to all fishing as a precautionary measure pending further study;

2. Michigan, Ontario, Ohio FDA and the U. S. Federal Water Quality Administration agreed to cooperate in developing further information on the Detroit River and Lake Erie;

3. Participants in the meeting agreed to continue and accelerate efforts to eliminate mercury contamination from all sources;

4. All parties agreed to consult with various other authorities prior to taking actions affecting waters of the Great Lakes;

5. All parties agreed to participate, with other authorities, in investigating additional dangerous substances as to kinds, amounts and effects;

6. All parties agreed to recommend the convening of a conference of the Governors and Prime Ministers of the Great Lakes States and Provinces;

7. All parties agreed to urge all respective federal bodies to initiate actions to investigate sources of mercury contamination in all states and provinces.

Ohio Department of Health determines Detrex Chemical Company of Ashtabula, Ohio a probable source of mercury contamination.

FWQA Lake Erie Basin Office, Cleveland initiates a water sampling program in Lake Erie and tributaries and participates in an inspection of the Detrex Chemical Company plant.

Wyandotte Chemical plant ceased mercury waste discharges to the Detroit River at 12:30 p.m. Mercury enriched waters are now being discharged in holding facilities for chemical treatment.

April 13, 1970

Governor Rhodes of Ohio announced a ban on commercial fishing in Lake Erie.

Ohio Water Pollution Control Board issued a "cease and desist" order to Detrex Chemicals Company.

FWQA Lake Huron Basin Office personnel met with Michigan State officials. The MWRC agreed to supply one man to aid in the field work collecting sediment samples and to share duplicate samples for verification purposes. MWRC to continue sampling effluents in the area.

April 14, 1970

FWQA Great Lakes Region Basin Offices provided with a list of chlor-alkali plants and asked to investigate as sources of possible mercury pollution.

April 16, 1970

The Wyandotte Chemical Company was issued a court order to cease discharges of mercury wastes in any form or amount. The plant ceased operation of the mercury cell room at 6:20 p.m.

April 21, 1970

Secretary of the Interior Walter J. Hickel announced his Department is initiating a massive campaign to clean up Lake Erie, as a result of reports of lethal discharges of mercury into the Lake and into the Detroit River which empties into Lake Erie.

In a series of steps, Secretary Hickel announced taking the following action:

— An enforcement conference on Lake Erie will be reconvened in Detroit, followed by enforcement workshops in Toledo, Cleveland, Lorain, Sandusky, and Ashtabula, Ohio; Erie, Pennsylvania; and Lackawanna, New York.

— The Secretary's special investigative task force has been assigned to obtain firsthand up-to-date data on the entire water pollution problem in the Lake Erie watershed.

— Increased monitoring and research will be initiated at the Fish and Wildlife Service's Great Lakes Fishery Laboratory at Ann Arbor, Michigan, on the toxicity of mercury and other metal compounds and their effect on fish and other aquatic life.

— The Federal Water Quality Administration has been directed to identify and prepare a list of all toxic substances now being discharged in waters throughout the United States.

April 23, 1970

Assistant Secretary for Water Quality and Research, Carl Klein, directed the Commissioner, FWQA, to take necessary immediate action to translate the Secretary of the Interior's announcements of April 21

into positive action. He also asked that the Task Force assigned to obtain firsthand up-to-date data on the entire water pollution problem in Lake Erie and coordinate with Michigan, New York, Ohio and Pennsylvania.

April 29, 1970

Prime Minister John P. Roberts of Ontario called a conference for June to discuss pollution problems in Lake Erie. The Prime Minister invited the Prime Minister of Quebec and the Governors of Illinois, Indiana, Michigan, Minnesota, New York, Ohio, Pennsylvania and Wisconsin.

April 30, 1970

Governor Rockefeller of New York announced that the Department of Agriculture and Markets began placing all fish caught commercially in Lake Erie under seizure to protect consumers from mercury contamination. The Department of Conservation advised sports fishermen against eating fish taken from Lake Erie. This action was taken after analysis of several New York fish samples showed levels of mercury in excess of 0.5 ppm considered acceptable for sale by the Food and Drug Administration. The Governor announced that the State Health Department also had tested drinking water taken from Lake Erie and that it had been found fully safe for human consumption.

Staff members of the FWQA Great Lakes Region met with members of the Secretary of the Interior's Task Force to develop plans for action required to implement the Secretary's announcement of April 21. Recommendations for appropriate field investigations and research projects were developed for Headquarters' consideration.

May 1, 1970

The State of Ohio rejected 11,300 lbs. of fish caught in Ohio waters of Lake Erie because of high levels of mercury (greater than 0.5 ppm.) The rejected fish were from 8 commercial catches of 5 fisheries and were primarily white bass, sheephead and catfish caught in the western basin and the western end of the easterly basin of Lake Erie. The samples analyzed consisted of 400 fish and contained mercury ranging from 0.51 to 0.64 ppm. The State of Ohio made the analysis.

May 4, 1970

Governor Warren Knowles of Wisconsin issued a 30-day emergency order closing 35 miles of the Wisconsin River for fishing due to mercury contamination. The Wisconsin Department of Natural Resources issued a cease and desist order to Wyandotte Chemical Corporation of Port Edwards to halt the discharge of mercury laden wastes into the Wisconsin River.

The Assistant Commissioner for Enforcement FWQA was requested by the Commissioner, Erie County Department of Health to conduct an extensive water and bottom sampling program for toxic materials and substances not only in the western basin but throughout Lake Erie. The Commissioner also requested a re-evaluation of the 1967 compliance schedule to determine whether any of the municipalities and industries not in compliance are contributing toxic discharges.

May 5, 1970

A representative from the Ohio Department of Health visited Reactive Metals Inc., Metal Reduction Plant in Ashtabula, Ohio to

obtain information pertaining to mercury discharges. Samples from the plant effluent and receiving tributary were collected for analyses.

May 6, 1970

Representatives from the Ohio Department of Health, and FWQA, Lake Erie Basin Office, either visited or contacted by telephone the following industries to obtain information regarding mercury usage:

Bailey Metal Co., Wickliffe, Ohio

General Electric Co., Cuyahoga Plant, Cleveland, Ohio

General Electric Co., Large Lamp Engineering and Pilot Plant, Cleveland, Ohio

Standard Oil Co. of Ohio, Cleveland, Ohio

The FWQA, Lake Erie Basin Office collected sediments samples from the Buffalo River for mercury analyses.

An effluent sample from the Cleveland Easterly Sewage Treatment Plant was obtained for mercury analysis by Lake Erie Basin Office.

May 7, 1970

Representatives from the Ohio Department of Health, and the FWQA Lake Erie Basin Office visited the following industries to obtain information pertaining to mercury usage:

National Aeronautics & Space Administration, Lewis Research Center, Cleveland, Ohio

Lincoln Electric Co., Cleveland, Ohio

General Electric Co., Powder & Wire Plant, Euclid, Ohio

General Electric Chemical Products Plant, Cleveland, Ohio

May 8, 1970

Regional Director, FWQA Great Lakes Region presented testimony

on mercury contamination in the Great Lakes to the Subcommittee on Energy, Natural Resources and Environment of the Senate Commerce Committee at Mount Clemens, Michigan.

Secretary of the Interior announced that the fifth session of the Lake Erie Enforcement Conference would be held on June 3, 1970 at Cobo Hall in Detroit, Michigan.

Representatives from the Ohio Department of Health and the FWQA Lake Erie Basin Office either visited or contacted by telephone the following industries to obtain information pertaining to mercury usage:

Union Carbide Corp., Electronic Components Div., Cleveland, Ohio

Union Carbide Corp., Carbon Products Plant, Cleveland, Ohio

Union Carbide Corp., Edgewater Works, Cleveland, Ohio

I. Miller Inc., Cleveland, Ohio

Merian Instrument Co., Cleveland, Ohio

Schuemann-Jones Co., Cleveland, Ohio

B. F. Goodrich, Avon Lake, Ohio

E. I. DuPont de Nemours Co., Cleveland, Ohio

Representatives from the New York State Health Department and FWQA, Lake Erie Basin Office visited the Allied Chemical Co., Buffalo, New York Dye Division, to obtain information on mercury usage. The New York State Health Department requested the Allied Chemical Co. to minimize the discharge of mercury and to report immediately of their steps for compliance.

May 9, 1970

Allied Chemical Corporation of Syracuse, New York diverted their

mercury bearing wastes to their settling ponds. Previously wastes were discharged to streams flowing into Onadaga Lake. The settling ponds being used for mercury wastes may still, however, overflow into streams flowing into Onadaga Lake.

May 11, 1970

A representative from the Ohio Department of Health contacted by telephone the following industries to obtain information pertaining to mercury usage:

Harshaw Chemical Co., Cleveland, Ohio

Bellows Electric Co., Akron, Ohio

Effluent samples from Detrex Chemical Co., Euclid Sewage Treatment Plant, and Cleveland Westerly and Southerly Sewage Treatment Plant were obtained for mercury analyses by FWQA Lake Erie Basin Office.

The Director, Lake Erie Basin Office notified the Regional Director, Great Lakes Region, that the Allied Chemical Co., Buffalo, New York is a source of mercury in the Lake Erie Basin. He recommended that New York State Health Department issue a desist order.

Wayne C. Bellaman, Regional Sanitary Engineer for the Pennsylvania Department of Health, announced the following:

1. Declared that concentrations of mercury in the waters of Lake Erie used for municipal and industrial water supply by the City of Eire are within the limits safe for domestic and industrial use and consumption. No concentrations of mercury in excess of 0.005 mg/l were found in samples of raw water collected from both of the City water works.

2. Selected municipal and industrial waste discharges were sampled, including the effluent from the City of Erie Sewage Treatment Plant and the Hammermill Paper Co. No concentrations of mercury have been confirmed in these discharges in excess of those from the waters withdrawn by the City of Erie and the Hammermill Paper Co. from Lake Erie.

3. The Erie County Health Department has been assisting in this investigation by checking hospitals and industries connected to the Erie sewer system. No potential major sources of mercury are known to exist within the Erie portion of the Lake Erie Basin.

4. Assured that if mercury is found in any of the waste discharges in excess of 0.005 mg/l, enforcement action will be initiated immediately to require immediate and complete abatement.

5. No mercury has been found in the tissue of fish collected from Lake Erie in excess of 0.5 mg/l limit set by the Federal Pure Food & Drug Administration and the World Health Organization.

May 13, 1970

Ontario and Michigan officials met in Toronto to reconsider the fishing ban and arrive at an agreement for possible reopening of fishing in Lake St. Clair, Detroit, and St. Clair Rivers. It was agreed that a catch and release restriction be imposed by both governments which will make possession of fish illegal.

Effluent samples from the National Aeronautics & Space Administration, Lewis Research Center, were obtained for mercury analysis by FWQA, Lake Erie Basin Office.

May 14, 1970

Ontario Officials announced the reopening of sports fishing in Canadian waters of Lake St. Clair and the St. Clair and Detroit Rivers. No catch and release restrictions were imposed; however, warnings on the eating of fish were made.

May 15, 1970

Governor Milliken of Michigan announced that a statement will be issued next week on Michigan's decision to relax the sports fishing ban on U. S. waters of Lake St. Clair and the St. Clair River.

Officials of the New York State Conservation Department closed all fishing in Onondago Lake at Syracuse because of mercury contamination. The State Conservation Department also recommended that fish caught in Lake Ontario and the Oswego River not be eaten.

The Wisconsin Department of Natural Resources held a public hearing concerning Wyandotte Chemical Corporation of Port Edward's discharge of mercury wastes to the Wisconsin River.

Regional Director, New York State Health Department, Syracuse, sent a telegram to Allied Chemical Corporation, Solvay, New York asking the Corporation to present the Department of Health a definitive time schedule for complete elimination of mercury from their liquid waste discharge. Allied Chemical was asked to respond by May 25, 1970. Similar instructions were transmitted to Olin Mathieson Corporation of Niagra Falls, New York. The Olin Mathieson Corporation was asked to meet with State Officials to discuss a suitable time schedule.

Representative from the Ohio Department of Health and FWQA, Lake Erie Basin Office visited the General Electric Company, Cleveland Lamp Plant, to obtain information pertaining to mercury usage.

A representative from FWQA, Lake Erie Basin Office visited the General Electric Company, Bucyrus Lamp Plant,to obtain information pertaining to mercury usage.

Effluent samples from General Electric Technical Products Plant were obtained for mercury analyses by Lake Erie Basin Office. The Regional Director, Great Lakes Region, advised the Deputy Commissioner, New York Department of Health, of findings pertaining to Allied Chemical, Buffalo Dye Division, and requested to be kept abreast of any enforcement action that may be pending. The New York Department of Health requested Allied Chemical Company to submit a schedule to eliminate mercury discharges.

May 18, 1970

Representatives from the FWQA, Lake Erie Basin Office, Ohio Dept. of Health, and the NFIC, Cincinnati, met in Columbus, Ohio to exchange mercury data.

May 19, 1970

Representatives from FWQA, Lake Michigan Basin Office and Illinois State Sanitary Water Board visited the Monsanto Company of Sauget, Illinois to inspect plant operations and sample plant effluent and sludge from the brine reaction tank.